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GRAMME.

France has given to electricity many of its most notable philosophers and inventors, and in the latter group no one was more prominent than Gramme, who has just passed away full of years and honors, interested in the art to the last, and one of the active attendants at the recent Paris Congress and Exposition. We do not forget that he was of Belgian birth, like Van Depoele, but all his work was done in France, with French aid, and from the French Government came the first recognition of the intrinsic value of his work. While doing him full honor ourselves, we cannot but reflect somewhat sadly on the fate of the American inventor Fuller, who, taking up in this country the crude Gramme machines of 25 years ago, did so much to put dynamo construction on a scientific industrial basis, but died poor and all too young to reap any reward.

THE TICKER.

Now that the stock printer, better—or worse—known as the "ticker," has fairly well crystallized as a machine and is not likely to undergo any radical changes or improvements, it is well to have its history summed up as Mr. Calahan has done it for us this week. Himself foremost in the development of a machine which has literally made and unmade more fortunes than anything else in this speculative land, Mr. Calahan furnishes a most interesting narrative in regard to the apparatus. One is apt to regard the telephone industry as being like Melchisedek or Japhet, without a progenitor, but in the distribution of bank and stock news, many of the fundamental features of telephony were worked out, and the evolution can be pretty closely followed by those familiar with the two branches of electrical application as Mr. Calahan is.

THE INSTITUTE PRESIDENCY

Of late years the practice has grown up in the American Institute of Electrical Engineers of making the presidential term two years, by re-election; so that unless a president received this compliment, it might almost be assumed that some kind of a reproach or stigma applied to the man who was able to hold the office for one year only. Now that the nomination ballots are going out to the members, President Hering, with the courage of his convictions, has requested us to give publicity to the fact that under no circumstances will he allow his name to be submitted for the candidature this year. It is well known that he has always been opposed to two-year terms, and his action at this juncture is in keeping with the admirable stand that he has taken upon the subject.

We must congratulate Mr. Hering on the benefit he has thus conferred on the Institute at the close of a year of distinguished service. If re-election can be earned, he has certainly made the strongest possible bid for the suffrages of his fellow members by the excellent work done since last May, including leadership of the visit of the Institute to England and France, active participation in the International Electrical Congress, and a personal honor to himself in the award of the coveted Legion of Honor for invaluable services as an Exposition juror on behalf of the United States. But it is obvious that if every president is to have two years, very few of the available men can ever reach the chair. The presidency of the Institute is justly regarded as the "blue ribbon" of the profession, and it is not fair to shut out from the prize those who might attain it on any reasonable basis of rotation in office. As a matter of fact, the majority of presidents of the Institute—such men as Thomson, Weston, Sprague, Anthony and Bell—have held office for one year only,

and Mr. Hering's fine example now affords the opportunity to revert to the earlier, healthier practice. All the later proposed revisions of the constitution have embodied the rule of a term of only one year, and so far as we know the minds of the members, the feeling in favor of such a restriction is universal among them. With a membership now approaching 1500, the Institute has had barely a dozen presidents in 16 years, and we make bold to affirm that there has thus been injustice done already to the men whom the Institute at large would delight in honoring on the sole ground of their engineering attainments or their contributions to electrical science.

STANDARDIZING ENGINE SPEEDS.

The distinguishing characteristic of modern manufacturing methods as compared with antiquated manufacturing methods lies in the standardization of parts and types and their rapid reduplication by machinery. Once the labor and expense of making the tools for the first machine have been paid for, successive copies of that machine can be made at a comparatively small expense. The same rule undoubtedly applies to dynamo-electric machines, and the large factories in this country have followed as far as possible the plan of developing lines of machinery suited to the average use and of standardizing them in such a manner as to admit of their reduplication at a low factory cost. This standardization is readily carried out in motors, where the voltage of the circuit or the voltage and frequency are themselves standardized.

In the case of generators, however, the matter is not so simple for the reason that the electric generator is only part of the generating plant, consisting of dynamo and prime mover. If the dynamo builder also made the turbine, or the steam engine, to drive the dynamo, there would be little difficulty in standardizing both for the best joint output. But as the matter stands to-day, the dynamo builder does not usually make the prime mover, and the prime mover builder does not generally make the dynamo. In the case of large alternators, therefore, when an attempt is made to purchase a large engine from one factory and a large dynamo from another, it is usually hopeless to meet the standard requirements of both manufactories. The result is that either the engine is made specially to suit the dynamo or the dynamo is made specially to suit the engine. In either case special tools have generally to be made for the manufacture of one machine, and not only is delay incurred by reason of the novelty of size, but also the expense incurred to both manufacturer and purchaser is increased relatively to that of standard machines. Not only is the purchaser burdened by the additional expense and the manufacturer burdened by the additional stock and labor, but future prospective or actual purchasers of machinery of the same class are hampered with some additional cost by reason of the additional delay in the shops and by reason of the departure from a recognized standard. In a certain sense and in a lesser degree, the entire foreign dynamo trade of the country is hampered by reason of the departure from the methods of scientific manufacture.

Unless, then, the manufacture of dynamos is taken over by prime-mover builders, or the manufacture of prime-movers is acquired by electrical manufacturers—in either case a very large increase of operations—the only hope is for both to agree upon standard sizes and speeds suitable for meeting the average requirements. There is already a tendency manifested to do this on both sides and a committee of the American Society of Mechanical Engineers, together with a similar committee from the American Institute of Electrical Engineers are understood to have further practical suggestions under consideration looking towards general recommendations to the manufacturers on both sides. It is earnestly to be hoped that in the interest of all parties concerned a useful and effective standardization can be brought about, with due care, however, that free development in either branch shall not thereby be hampered.

SYNTONIC AND MULTIPLE WIRELESS TELEGRAPHY.

In the Digest of last week a concise account was given of the Slaby system of tuned and multiple wireless telegraphy, which system has recently been the subject of some successful experiments in Germany. As will be seen, the selective or syntonic feature consists first, in corresponding stations working with the same wave length, and in the employment at the receiving station of a vertical wire equal in length to a sub-multiple of the wave length agreed upon. By this means the receiving instrument will not respond to wave signals sent from the same or other stations where this condition is not complied with. Moreover, by a certain disposition of the aerial conductor it is made possible to receive simultaneously at a station messages of different wave length—this part of the system thus corresponding to multiplex wire telegraphy. Another part of the system consists in an "intensifier" arrangement corresponding to the local battery circuit of an ordinary telegraphic system, by means of which the potential of the received wave is increased, resulting in an increased effect on the coherer. The work of Prof. Slaby forms the most important contribution recently made to wireless telegraphy, and the system also appears to be a practical one. In tests made some weeks ago before the German Emperor, simultaneous messages were successfully received from two stations, one eight and the other two and one-half miles distant from the receiving point. The waves from the more distant station had to pass across the city of Berlin and were naturally attenuated by the high buildings and chimneys in its path, which effect, however, was counteracted by the application of the "intensifier" principle.

The work of Dr. Slaby above referred to received considerable prominence in cable newspaper dispatches, and—not unexpectedly—Mr. Nikola Tesla now comes forward with a claim of priority. In a letter to the New York *Sun*, Mr. Tesla says he has read with "deep astonishment" the statements made in his lecture before the Emperor by the Charlottenberg professor, who, moreover, had acknowledged that he—Tesla—is the "father of wireless telegraphy." Mr. Tesla also expresses disappointment that Dr. Slaby does not give him credit "for a beautiful invention which he [Dr. Slaby] calls the 'multiplier.'" "Have I not first described this device," he says, "and given rules for its construction and attunement? Was I not the first to apply it to wireless transmission?" For obvious reasons we have not been able to keep pace with all the numerous newspaper ascriptions to Mr. Tesla of revolutionary discoveries in electrical science, which probably explains our ignorance of the claim that he is the "father of wireless telegraphy," or indeed that the art of wireless telegraphy has in any manner benefited from his labors.

If Mr. Tesla would do what may fairly be asked of a man of his prominence—prepare a paper for the American Physical Society or the American Institute of Electrical Engineers covering the work he has accomplished in this branch—we shall be able to repair our own seeming neglect in not laying before our readers hitherto the record which would entitle him to be called "the father of wireless telegraphy."

CAPACITY OF ELECTRIC CONDUCTORS.

In our issue of last week we quoted from a letter over the signature of Mr. Nikola Tesla in the New York *Sun* of Jan. 30, in which it is stated that the capacity of a fixed insulator conductor is not a fixed quantity, but varies with the hour of the day, with the season of the year, that it is influenced by moonlight, etc. It is also intimated that in consequence of this newly discovered fact a large part of technical literature will have to be rewritten. May we venture to express our doubts upon these propositions, with all due deference to Mr. Tesla. So far as text books are concerned, they are only stepping stones, and not keystones, in the structure of our

faith. The sooner they have to be cancelled, amended and rewritten, the healthier and more sturdy the growth of the science to which they relate, but the evolution of text books and of the knowledge they disclose must be like all other evolution, in a definite and orderly manner, in obedience to certain rules.

We have every reason to believe that the capacity of the condensers in our laboratories is within certain small limits a definite and constant quantity. The capacity of aerial wires insulated on poles and supported many feet from the ground seems to be a substantially constant quantity from day to day and year to year, provided that the surface of the earth is uniformly conducting. It has long been known—though not, it would seem, by Mr. Tesla—that when the surface of the earth is dry and ill-conducting, the apparent capacity of single wires supported above it is less than when the earth is wet and well-conducting. If, therefore, Mr. Tesla refers to variations of capacity between a fixed aerial conductor and the ground due to variation in the conductivity of the surface soil, he is virtually repeating a known proposition.

Concerning the variation in capacity of a conductor relatively to the earth with elevation above the earth, it is not a discovery that there must be a change of some sort in capacity. The experimental knowledge we possess concerning the capacity of very elevated conductors, is, however, so limited that there is room for valuable technical results to be observed in this direction, and if Mr. Tesla has made reliable observations of this character the science would owe him so much the more for their announcement. We hope that Mr. Tesla will publish any results which he may have obtained, in such form as may be available to electrotechnical workers.

It is quite clear that not only is no substantial technical information imparted to electrical engineers by articles of the nature which Mr. Tesla communicates so frequently to the daily press, but also that it is impossible for an electrical engineer to judge from such articles of the validity of the conclusions which are therein reached. It is quite possible that the apparent capacity of very elevated conductors might vary in a manner not generally appreciated or understood, and yet that the capacity of the ordinary conductors in the neighborhood of good conducting ground should be as fixed and constant a quantity as has always been supposed.

RESONANCE AND "STATIC."

We print elsewhere an interesting letter from Dr. F. A. C. Perrine on certain phenomena sometimes classified as resonance. He deals particularly with the sparking around switchboards and other points in the connections known in the vernacular as "static," and suggests that many or most cases of this kind may properly be charged up to plain lack of sufficient insulation. There is small doubt that his position is for the most part correct, and he has assuredly done an excellent thing in calling attention to the so-called static discharges with which every electrician who has worked around high voltage stations is familiar. Of course, there is such a thing as a genuine static charge on an overhead line, due to purely atmospheric causes, and we have known workmen to get sharp shocks from lines quite disconnected from any circuit and neither crossed nor paralleled by any circuit. When a thunder storm is in progress there may be greatly increased differences of potential and snapping discharges from overhead wires which yet by no means rise to the dignity of lightning.

But as to "static" of the genuine kind playing the roles often attributed to it—that is a very different matter. When there is a steady stream of spark discharge from a high-voltage line in the absence of any particular atmospheric disturbance, it is quite safe to say that, whatever else it may be, it is certainly not a static discharge of any kind; and the steadier and fiercer it is, the more surely can it be traced to the energy properly belonging to the line. If the discharge follows along or in the material of a slate or marble switchboard, there is no reason for crediting it with any extraordinary voltage, and it is simply amazing to find how many crevices and conducting streaks there are in these materials, particularly the former. When the discharge is sneaking along such surfaces there is little need of invoking resonance or any other unusual cause in explanation.

But there certainly are many cases of discharge from high voltage lines through the air in which the line voltage is absolutely inadequate to account for the sparking distance. The striking distance of various alternating voltages between needle points is well known from direct experiments, and when, for example, one finds a discharge steadily streaming and singing across gaps aggregating an inch or more between the cylinders of a high voltage arrester, the line voltage being only 10,000, there is need of more explanation than leakage will furnish unless the discharge is shown to be along a surface. This should be sought as a possible explanation, on the other hand, before calmly charging up the case to resonance. If a steady spark discharge visible through air takes place over a distance two or three times as great as the sparking distance due under the most favorable conditions to the line voltage, then it is time to look into the question of resonance. And if in addition a violent discharge of this kind occurs simultaneously with a sudden disturbance of the electrical conditions on the circuit, it is high time to examine the conditions of resonance on that line. For example, a case recently came under our notice in which the burning out of a ground detector in making a test was instantly followed by a discharge across a bank of lightning arresters two miles distant that leaped double the striking distance due to the voltage and utterly demolished the arresters. Within a few months on the same system, opening a switch shot a 10-inch discharge across air from the switch point to a cut-out on another phase, with a nominal voltage of less than 5000 to help it on its way. In general, phenomena of this sort suggest resonance too forcibly to justify neglect.

But it is by no means easy to tie up the facts of resonance with the theory thereof. For unless one has a rather precise knowledge of the e. m. f. curve of the generators upon the system, it is no easy matter to know what harmonics are likely to cause trouble, and even then the change of the harmonics under varying conditions of load requires examination. And even were these known the capacity and inductance of the system are by no means easy of determination. If only the line were concerned all would be smooth sailing, but the constants of the system involve the apparatus as well as the line, and the effect of this is very difficult to compute. Under certain conditions the capacity of large transformers and the like may enter, causing resonance with harmonics that would be quite unsuspected on the evidence of the line alone. This whole question of discharges of abnormal length on high voltage lines deserves a thorough examination, for it involves some very singular phenomena. Static discharges there certainly are, and leakage discharges, and resonant discharges. When the latter occur under conditions that make their nature clear, they are sometimes very violent, but sparking of a more trivial nature is a bit dubious in character and deserves as much investigation as if it were highly dangerous. For example, we remember noting once a clear brush discharge from the corner of a switch into the surrounding air, which persisted steadily for a considerable time, although the voltage was a scant 3000. It is certain that there are encountered on high voltage lines very abnormal sparking distances which are not to be accounted for in any simple way, and an investigation of which may lead to very interesting results

Death of Zenobe Theophile Gramme.

Zenobe Theophile Gramme died at Bois Colombes, near Paris, on Sunday, Jan. 20. Gramme was born at Jehay-Bedegnee, near Liege, Belgium, in 1826, of poor parentage, and early in life learned the trade of a carpenter. Not content with this occupation, he attended scientific lectures at Liege and afterwards went to Paris, where he obtained employment as a fitter in a factory where the "Alliance" dynamo was constructed—the first dynamo-electric machine to enter into practical use. Later he worked under Ruhmkorff in his celebrated ateliers, and up to the time of his great invention followed the occupation of a machinist.

The first patent on the Gramme ring dynamo was taken out in 1870, the date of the English patent being June 9 of that year, and his first machine was submitted to the French Academy of Sciences in July of the following year. In 1872 Gramme constructed a machine with three ring armatures on the same shaft, which was used in the production of the electric light in a competitive trial with gas light for illuminating the lantern of the clock tower on the Houses of Parliament, London. Among some of the earlier machines made by Gramme was a type for use in the Russian and French navies.

In relation to the original English Gramme patent, Prof. S. P. Thompson relates a curious history. "It may appear strange," he says, "that so slight a specification—a few lines of description, a

THE LATE Z. T. GRAMME.

single claim, unaccompanied by any drawing—should constitute the whole of the patent of Gramme and d'Ivernois. The simple fact is that at the date when the filing of the final specification became due Paris was besieged, and it was impossible to send drawings to the London agent, who simply filed the materials that were to hand." The rapid commercial success of Gramme's machine, Prof. Thompson ascribes to the fact that it was the first practical machine in which were combined the features of the continuity of commutation, the self-exciting arrangement, good lamination in the armature core, and reasonably good proportions in the magnetic circuit.

With each succeeding year Gramme improved his direct-current machine, and those exhibited at the Paris Expositions of 1878 and 1881 had already arrived at the definitive form which so largely influenced the development of the electrical industry. Gramme received many honors on account of his invention. The French Government awarded him a prize of 20,000 francs, and from the Academy of Sciences he received the Volta Prize, carrying with it the same amount of money. He also received decorations from the French Government and several of the European governments.

In 1877-78 he designed and supplied a number of alternating current machines for the operation of the Jablochkoff light. In these machines the field revolved and the armature was stationary, and the latter was so wound that a number of circuits could be led from it. In the case of one machine, 32, 16, 8 or 4 circuits could be supplied from one machine, according to the manner in which the coils were connected. In 1879 he produced a machine for Jablochkoff lighting which combined in one structure a direct-current exciter and an alternating current generator.

Up to the end of his life Gramme retained his connection with the original company founded to manufacture his apparatus—the Société Gramme—though in recent years this connection was merely nominal. In a letter just received from a Belgium correspondent we learn that Gramme persistently refused to become naturalized in France and died a Belgian subject. The accompanying portrait was engraved from a photograph which Gramme had specially taken for the historical collection of Mr. W. J. Hammer.

New York Electrical Society.

One of the most brilliant and successful meetings of the New York Electrical Society was held on Jan. 30 at the Edison station of the New York Gas & Electric Light, Heat & Power Company, Elm and Duane Streets, where Dr. Louis Bell delivered an experimental lecture on the subject of "Electrical illumination at the beginning of the twentieth century." The society were guests of the company, who, by arrangement, also invited electrical contractors doing work on their system to participate. Members were also permitted to bring ladies, so that in spite of the fact that the first snowstorm of the winter was in hearty progress, no fewer than 450 people gathered in the large central hall of the company's office floor. This and the surrounding gallery, hallways, etc., were filled with seats, and even then many remained standing. At one end a platform was built, with temporary switchboard, banks of lamps, etc., so that Dr. Bell was able to illustrate his remarks with every kind of lamp and every kind of current, as noted in the report given elsewhere in these pages of his able, fascinating and instructive address. A speech of welcome by Mr. John W. Lieb opened the exercises, it being accompanied by an admirable little historical epitome of the electrical art as illustrated in the frescoes running around the hall. After the lecture, an enthusiastic vote of thanks was passed on motion of Messrs. Sheldon and Mailloux to Messrs. Murray, Brady, Lieb and other officers of the company, for their courtesy, and to Dr. Bell for his lecture. Thereupon a collation was served by the generous hosts, and visitors were afterwards allowed to inspect the station, under the direction of Messrs. Arthur Williams, Burnett, Littlefield, Donshea, Shepherd and other officials, who did everything in their power to make their guests at home and to impart information. It was universally agreed that although noted for the uniform success of its "visiting trips" the society had never had a more delightful evening than this—the first in the new century. By arrangement with Dr. Bell, the lecture was repeated the following evening by Mr. J. W. Lieb for the benefit of the staff and force of the company.

During the evening the following new members were elected: J. L. Kebler, vice-president Ward Leonard Electric Company; W. P. Henshaw, New York Telephone Company; W. I. Donshea, superintendent, with New York Gas & Electric Light, Heat & Power Company; H. L. Patteson and H. J., Fuller, with Crocker-Wheeler Company, Ampere, N. J.

Street Railway Legislation.

The Massachusetts Railroad Commissioners have submitted that part of their annual report on street railways having to do with recommendations connected with legislation. The present street railway laws are termed patch-work, partly inoperative and often conflicting, being first adapted to horse car service. A general revision, however, may be postponed, as a special revision has been made by able authorities. It would be well to let experience keep school a while longer. As to giving street railways power to carry on freight business and run over private land, the commission believes there is yet no call for thus having the street railway work against, not with, the railroad. The commission recommends that if it is to regulate fares it be given full opportunity to exercise this power. The roadbed, tracks and structures of new companies should be inspected by the commission before the railway is opened. During 1900 the board approved stock issues aggregating at par $14,538,000, and bonds aggregating $4,085,000, against $15,360,500 stock and $4,204,000 bonds asked. Investigations have shown impairment of capital or assets in five cases, all of which, to the extent of $203,921, was made good. The anti-stock-watering laws are commended as protecting investors from over-capitalization. Exemption from these laws should be granted only under unusual conditions. Thirteen street railway consolidations have been effected during the year. Consolidations have been accompanied by reductions in fares and the extension of the transfer system.

The Automatic Telephone Exchange at New Bedford, Mass.

BY ALTON D. ADAMS.

SCIENTISTS tell us that types reach perfection only to disappear. Some may therefore hold that the time for the passing of the "Telephone Girl" has come—presuming she is perfect. Whatever the soundness of this argument, it is a fact that a strong tendency exists in telephone development, away from manual operation at exchanges. A concrete example in this line is found in the system of the Automatic Telephone Company, of New Bedford, Mass. This corporation is organized under Massachusetts law, with a paid-in capital of $100,000, nearly all of which has been invested in the exchange which occupies the first floor of an excellent brick building owned by the company, at 41 William Street, in the center of the business district. This building is about 50x90 ft. on the ground, and three stories high, the two upper floors being let to other parties by the Automatic Telephone Company. As all of the telephone cables enter the basement of the building, the first floor is the one best suited for the exchange. The system at this exchange is adapted for 10,000 subscribers, automatic instruments have been installed, with a capacity of 900, and about 500 are already connected.

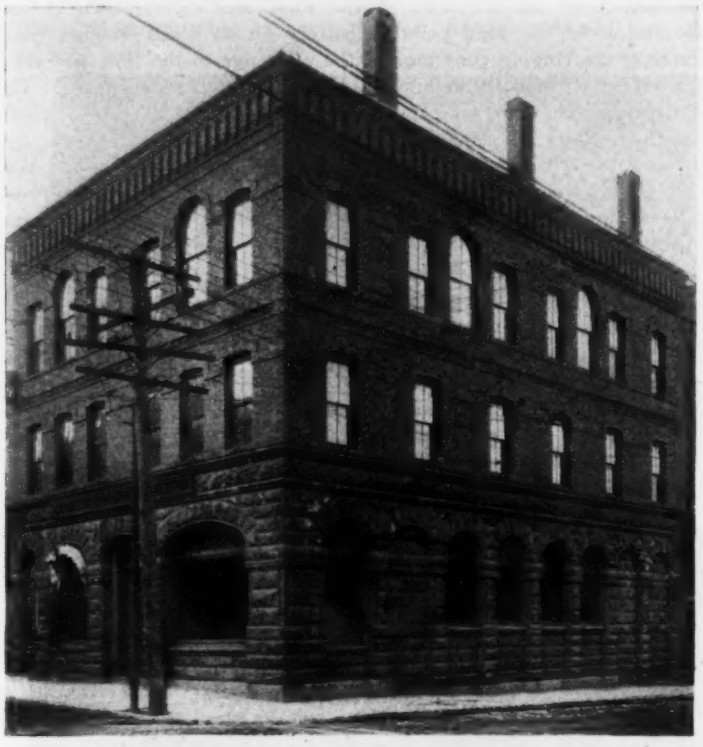


FIG. 1.—AUTOMATIC TELEPHONE BUILDING.

All telephone lines leave the exchange through underground conduits of wooden pipe, laid in cement concrete. The subways contain 40 of these wooden ducts at the exchange, whence they extend through the principal business streets, with manholes for nearly every block. Single wooden ducts to a total length of 124,000 ft. are included in these subways. The leaded telephone cables thus far installed include 5000 ft. of 10 pair, 8000 ft. of 25 pair, 25,000 ft. of 50 pair, and 30,000 ft. of 100 pair for subscribers' wires. There are five miles of underground conduits, two miles of overhead cables, and about 10 miles of open-line construction on the poles of the Automatic Company.

The New Bedford automatic exchange began business in November, 1900, and has steadily gained in popular favor, a considerable number of new customers being constantly on the list waiting for connection. Before the automatic exchange was opened the yearly rates charged by the older telephone company at New Bedford, for an unlimited number of calls by a business house, are said to have ranged from $48 on party lines to $96 on private lines. The rate charged by the Automatic Telephone Company for unlimited service on private lines is $24 per year in residences and $36 per year in business houses.

The Automatic Telephone Company, of New Bedford, uses the equipment made by the Strowger Automatic Telephone Exchange Co., of Chicago, under license from the Eastern Automatic Telephone Company, of John Hancock Building, Boston, this last corporation controlling the apparatus in the States of Massachusetts and Rhode Island. As the readers of this journal are generally aware, it is the distinct feature of the system, compared with manual exchanges, that each subscriber is able to call any desired number by a few simple movements at his own telephone, and is at once automatically connected to the required number by a private line.

In this series of operations no person save the one calling has any part. If the number called is already engaged with some third instrument, the person calling cannot break in on the conversation, but is automatically warned that the desired number is in use.

FIG. 2.—OFFICE AND SWITCH ROOM, AUTOMATIC EXCHANGE.

The automatic telephone exchange does with machinery exactly what is done at a manual exchange by the operators, that is, it connects the telephone calling to the desired number. The operat-

ing room at such an exchange has no operators, save the little machines that instantly respond to every signal sent over the lines from any subscriber. At New Bedford, only a single attendant is employed in the operating room to look after the machines, and even he is absent a considerable part of the time. As a large part of the cost of operation for a manual system is included in the wages of the telephone girls, it is evident that automatic telephones must effect a material saving in this particular. A further important and distinctive feature of the Strowger system is the absolute secrecy of conversation had over its lines. Not only is it impossible for any third subscriber to break in on, or to overhear the conversation between any two telephones, but no one at the exchange is in a position to listen to the talk of any subscriber, as an operator at a manual exchange may readily do. If any number called is shown to be busy by the automatic action of a buzzer, the call may be repeated as often as desired without disturbing the parties engaged in conversation, and the desired number may be obtained by a call as soon as it is released, without waiting for the attention of an exchange operator.

If a certain number of subscribers wish to so connect their telephones that each may hear all that is said by any of the others, as is at times the case with boards of corporation directors or college faculties, this result may be attained by either a permanent or temporary arrangement at the exchange, whereby each subscriber may call and automatically obtain connection to a certain number set apart for the purpose.

Another special feature is that any subscriber may be limited as to the number of telephones that he can call, or from which a call can come to him. This feature is said to be of advantage in the cases of certain important officials, such as train dispatchers. The cost to an exchange of unlimited is only a little more than that of limited service to its subscribers, because no manual element is involved in the automatic connections.

If it is desired, however, to limit the service to some subscribers, this can be accomplished by means of a record automatically made at the exchange of the number and duration of calls for each telephone. The savings to be made by limited service include a small amount of wear on telephones and on the exchange apparatus, also the energy required for their operation.

Energy to work the automatic apparatus at exchanges and to ring the call bells of subscribers is furnished by storage batteries and motor generators in exchanges of the Strowger system. A primary battery is retained in the telephone box on the subscriber's premises, but the current from this battery simply serves to actuate magnets that connect the generator for ringing to the line when desired. In calling, a subscriber does not turn a generator crank, but first makes a series of connections, corresponding to the number he desires, and then connects the ringing generator at the exchange to his line by pressing a button on his telephone box. Figures from 0 to 9 are indicated on a small metal dial, with a finger-hole opposite each number, located on the front of each telephone box. This dial may be revolved by hand in the direction of the hands of a clock, until any figure and finger-hole on it is brought to the lowest possible position, then when released it immediately turns back to its original position. When the first figure on the dial of the number wanted is turned to its lowest point an electrical connection is made, and the automatic apparatus at the exchange begins a movement toward the selection of a number that contains that figure in the extreme left-hand place. When the figure second from the left hand in the number wanted is turned to its lowest position by revolving the dial, the apparatus at the exchange makes a further movement toward the selection of a number that contains the two figures, in the order selected, at the left-hand end. The movement of other figures on the dial to the lowest position produces like action of the selecting apparatus at the exchange until the number wanted is complete and the connections are made. A pressure of the button on the telephone of the subscriber calling then closes the circuit of the local primary battery on an electromagnet that connects the ringing generator at the exchange to the line, and this rings the bells of both the number called and of the one calling. To illustrate this method of calling: Take the telephone number 5762. The figure 5 on the dial is first brought to its lowest position by revolution of the dial in the direction of the hands of a clock, the dial is then released and as soon as it has automatically returned to its original position the figure 7 is in like manner brought to its lowest point and the dial again released. This operation is then repeated for the figures 6 and 2 successively. The receiver is removed from its hook before the dial is moved to make a call, and after the conversation is finished the receiver is returned to its hook and then again removed before a second call is made. No ring off is necessary or possible in this automatic system, as the weight of the receiver on its hook opens the circuit and all of the connections between the two telephones engaged in conversation are at once released.

One second is sufficient time in which to bring any figure on the dial to its lowest position and allow its return; one second is also ample time in which to press the button and get a ring at both telephones. Five seconds is thus about the average time required to make calls on a system of numbers having four figures each. Conversation over the lines of the automatic system is quite as clear and satisfactory as that to be had through manual exchanges, as the writer can testify from his own experience in calling some of the most distant subscribers on the lines of the New Bedford Company. Several city officials and prominent business houses were engaged in conversation by the writer, through their telephones of the automatic system, and in every case entire satisfaction was expressed with the prompt and distinct qualities of the service.

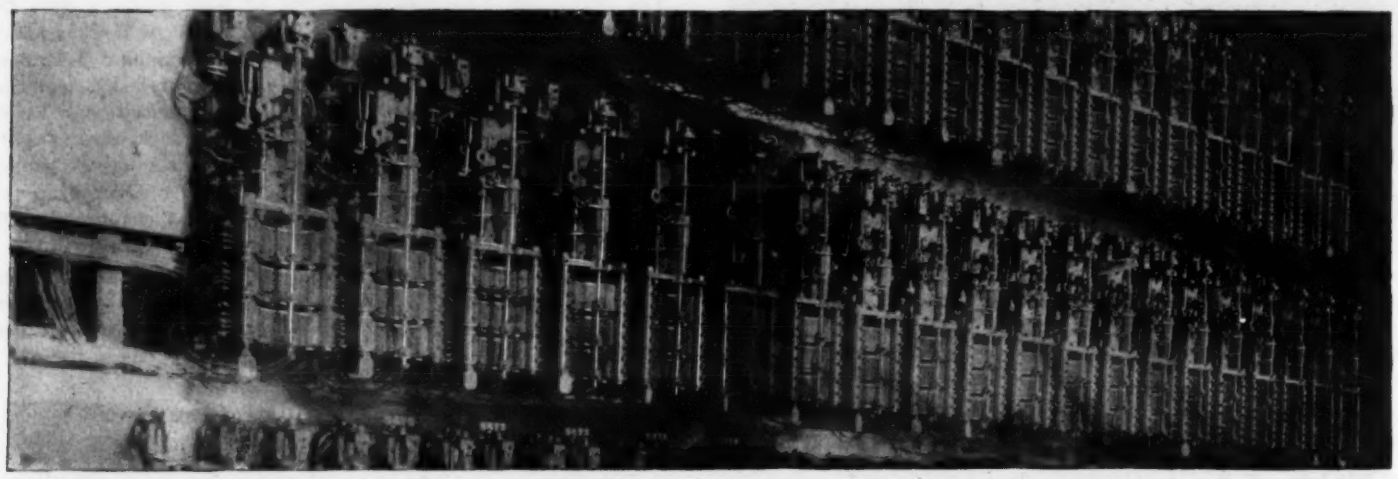


Fig. 3.—A Portion of the Switchboard, Automatic Telephone Exchange.

Each telephone on the automatic system is connected to the exchange by a complete metallic circuit of two wires. When the dial with figures is rotated on any telephone, the connections of these two wires are so varied that impulses of current operate the electro-magnetic mechanism at the exchange in a way to produce connection between the metallic circuit of the calling telephone and that of the telephone called. The push button that is operated as soon as a call has been made, introduces the earth as a third conductor between the two telephones and the exchange, but this connection to earth lasts only while the ringing apparatus at each telephone is in operation, and the line over which conversation is carried on is entirely metallic.

At the exchange each pair of wires from subscribers' telephones is connected to a small machine contained in a space less than 12 x 6 x 6 in., that is the essential element of the system. This little ma-

chine is made up of moving contacts, actuated by electro-magnets, the energy for these magnets being drawn from the battery at the exchange and controlled in its application by the rotation of the disk on the subscriber's telephone. In exchanges with 100 subscribers or less only one of the small machines just described is necessary for each subscriber. For this case the machine belonging to the calling telephone makes connection at once with the machine belonging to the telephone called. It is also possible to extend this system of one machine for each subscriber to a case where as many as 200 telephones must be served. In a larger exchange, up to 1000 subscribers, the connections of machines corresponding to each telephone must be made through one of 10 trunk lines, each of which leads to a group of similar machines. One of the machines on the trunk lines then makes an automatic connection with the machine corresponding to the telephone of the desired number. Where the number of subscribers is larger than 1000, a so-called 10,000-system, such as that at New Bedford is used, where each trunk line, first connected with a calling telephone, selects another trunk line, and this in turn the machine of the telephone desired. The 10,000-system involves the use of about one and one-half machines at the exchange per subscriber served. The present state of patent claims on the system do not permit drawings of the automatic machines and line connections to be presented at this time. It should be noted that as this system is made up at the exchange of a number of exactly similar automatic units, any desired extension of capacity can be made by additions of these units, without changes in those already installed.

With these general principles of the system in mind, we may return to the exchange of the New Bedford Company, to consider the apparatus by which the lines are connected to the automatic apparatus and the energy for operation is supplied. The underground cables end at the exchange in cable terminals, which are in turn connected to a very compact distributing board, that has contacts for 1600 subscribers on a surface 5.5 x 5.25 ft. These cable terminals and distributing board are shown in one of the accompanying cuts (Fig. 5) near dynamotor. The dynamotor operates at 110 volts, and is of 1-3-hp capacity. Energy for the magnets in the automatic machines is drawn from either of two storage batteries, one battery being of 20 and the other of 80 ampere-hour capacity, and each composed of 50 cells. These batteries are charged through a resistance from the 220-volt mains of the local light and power company. These batteries were furnished by the American Battery Company, of Chicago, and the cable terminals and fuses, also the pole top terminals were made by the Sterling Electric Company, of the same city. The dynamotor is from the Holtzer-Cabot Company, of Brookline, Mass. The wooden conduits came from the

FIG. 4.—SWITCHBOARD AND TELEPHONES, AUTOMATIC TELEPHONE EXCHANGE.

Williamsport Wooden Pipe Company, Williamsport, Pa. Switches and switchboard were supplied by the local Hill Electric Company, and the Standard Underground Cable Company furnished the leaded cables.

It is the intention of the Automatic Telephone Company, of New Bedford, to extend its lines to a number of towns within a radius of 10 miles at an early date, and also to Fall River, 14 miles distant, by next spring. At Fall River a Massachusetts corporation has been formed to erect and operate the automatic system, with a capital of $135,000. A large amount of underground work is already in at Fall River, a vitrified conduit being used, and the contract for a large exchange building has been let. This exchange

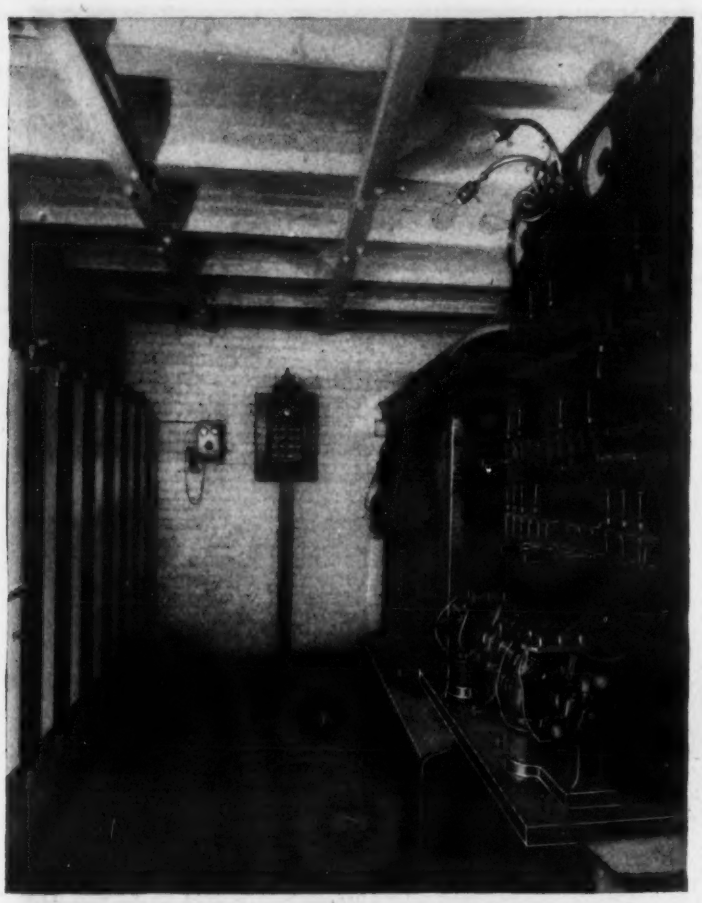


FIG. 5.—TERMINAL ROOM.

is expected to be in operation during the early summer. Meantime, the Hampden Automatic Telephone Company has been organized at Springfield, Mass., to install and operate exchanges in Hampden County. All of this serves to indicate that the automatic telephone system is here to stay, and is demonstrating an economy and practicability that many have doubted.

Calcium Carbide in Europe.

Mr. S. W. Hanauer, Deputy U. S. Consul-General at Frankfort, Germany, reports as follows: On Nov. 30 last, the convention of Swiss, Austrian, Swedish, Norwegian and German manufacturers of calcium carbide, which was in session at Frankfort, combined in establishing price schedules and a mode of controlling the sale of their products. The Deutsche Gold und Silber Scheide-Anstalt, of Frankfort (which has branches in the United States and other countries), was appointed the sole agent for the sale of the syndicate's products. It is expected that by this combination the acetylene industry will be considerably strengthened. The members have adopted measures to avoid the fluctuating and ruinously low rates which, owing to heretofore existing sharp competition, have made the manufacture of their products unprofitable. The German acetylene industry is very important, there being at present in the Empire over 200,000 plants making the gas. New patents for improved methods of production are constantly being issued. Thirty-two of the smaller towns in Germany are lighted by acetylene gas, and a number of other plants are in course of erection. The gas is also used by the railroads for lighting passenger cars. This year's production of calcium carbide in Germany is estimated at 20,000 metric tons, equivalent to 360,000 hectoliters (9,500,000 gallons) of petroleum.

Placer Mining Dredges in California.

SEVERAL placer mining dredges in California are now using electric power supplied by water power transmission plants in their vicinity. One of the largest of these dredges is at Sailor Bar, on the American River, about 6 miles from Folsom. It is supplied with power from the transmission line of the Sacramento Electric, Gas & Railway Company, which has its power plant at Folsom on the American River, and transmits 22 miles into Sacramento at 11,000 volts. To supply power to this dredge a small sub-station was erected in which were put three 325-kw oil-cooled transformers stepping down to 500 volts. From the sub-station to the dredge the current is carried by three 350,000 circ. mil. cables wrapped together. The cable is put on saw horses, which can be moved as the dredge moves.

These dredges are among the more recent developments in placer mining methods, and they afford a means of washing over placer deposits for the extraction of gold where water under high head for hydraulic operations is not available, or where it is desired to work the river bottoms. This particular dredge is designed to work into the banks of the stream above water level. It floats in a pond of its

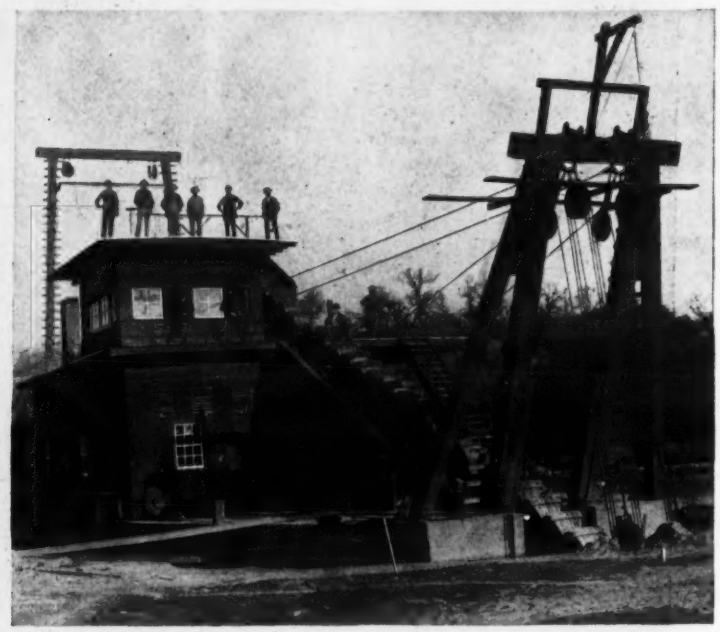


FIG. 1.—DREDGE WORKING INTO BANK.

own making, dredging into the bank in front, washing the dredgings for gold and discharging the tailings behind it into the pond so that the pond is kept constantly the same size, although continually shifting as to location.

The accompanying illustrations show the dredge of the Ashburton Mining Company previously mentioned. The buckets are of heavy cast steel, weigh 82 lbs. each, and form an endless chain. Fig. 1 shows the dredge with the buckets working into the edge of the bank and in Fig. 2 they are down in the water, working near the bottom. To operate this chain of dredge buckets a 150-hp, three-phase, variable speed motor is used. The dirt is carried up by these buckets and dumped into a revolving screen, which takes out the larger stones and lets the remainder fall into a sluice box, where it is carried down by a stream of water over riffles, which catch the gold and let the dirt be discharged as tailings behind the dredge. To drive the revolving screens and the pumps which furnish water to wash the dirt through the screens a 75-hp, three-phase motor is used. To run the 26-in. centrifugal pump, which furnishes a large volume of water to the sluice boxes, another 150-hp, three-phase motor is used. On the dredge there is also a 20-hp hoisting motor running winches for raising the buckets and moving the dredge, and for working two spuds, which run down into the mud under the dredge for holding it in place. As the level of the pond in which the dredge floats may be above the level of water in the river it is necessary to have a pump for keeping the pond full. This is done with a centrifugal pump run by a 40-hp, three-phase motor. All the electrical equipment is General Electric Company's manufacture, and the wiring was done by the Sacramento Electrical Engineering & Supply Company.

Another large dredge electrically equipped with induction motors is the "Continental," operating near Oroville. In this the electrical

equipment is somewhat similar, but is of Westinghouse make. This is supplied by the Bay Counties Power Company.

The use of electric motors is very attractive to the owners of such dredges, because of their simplicity and ease of control. Engines and boilers of sufficient capacity to do the work done by the motors on the dredges mentioned would be very cumbersome and expensive as compared to the motors, and a much larger crew would be required to operate the dredge. Although the field is not a very large one for supplying power for this kind of work, many of those familiar with the local conditions believe that with power available there will be a rapidly growing demand for power from dredges which will go over ground which has been hitherto untouched because of the cost of handling the dirt in former days. Lower wages, cheaper power and improved machinery make possible the working of placer gold deposits that have hitherto been passed over as unprofitable. Most of the hydraulic placer mines in California were stopped by the law which forbade discharging the tailings from such mines into the rivers. This leaves the dredges the only cheap method at present known for working placer dirt.

The Bay Counties Power Company is supplying electric power to seven dredges in the vicinity of Grass Valley and Nevada City in Nevada County, which call together for 800 to 900 hp, and from the way dredges are increasing in number it would not be surprising if 2500 hp were called for for that purpose in another year. There is an enormous amount of placer ground, as gold exists in all the river bottom deposits in some localities, and these cover a large area. The financial returns from the dredges in operation are not public, but from the way they are increasing in number it is not unlikely that they are many of them very good dividend payers. The common report is that any ground that will yield 10 cents a cubic yard in gold can be worked at a profit.

FIG. 2.—PLACER DREDGE WORKING ON BOTTOM OF POND.

The Roentgen Society.

The Council of the Roentgen Society, London, announces that the president has placed at its disposal a gold medal to be awarded to the maker of the best practical X-ray tube for both photographic and screen work. The competition is open to makers in any country. The jury will be chosen by the president and council of the society, and their names will be announced in the London *Times* of March 1. Tubes intended for competition must be sent in addressed to the Röntgen Society, 20 Hanover Square, London, W., marked "Tube for Competition," the package containing full name and address of sender, and must reach the society not later than May 1, 1901. Conditions can be obtained on application to F. Harrison Low, M. B., honorable secretary, 12 Sinclair Gardens, West Kensington, London, W.

Some Recent Tests of Magnetic Circuit Breakers.

BY HUGH A. BROWN, E. E.

THE following investigation formed part of a graduation thesis in electrical engineering at Columbia University, the object being to determine how accurately circuit breakers act, with what definiteness they open, how the current rises in the circuit before the breaker finally opens, and how the time required for opening varies with different overloads and settings. The general method was similar to that employed by Messrs. Clark and McMullen, Class of '97, in a similar investigation.*

In testing, the overloads were prearranged by adjusting the resistance in a 115-volt circuit to give the definite overload current required for any test. The current was then thrown in by means of a main switch, and the time which elapsed from the moment the switch was closed to the moment when the circuit breaker opened was measured. The method of measuring the duration of the period in which current flowed in the circuit was as follows: A wooden drum 47 in. in circumference and about ½ in. thick was arranged so as to be driven by a small shunt motor. On the periphery of this drum was placed a smooth strip of German silver which was a little wider than the thickness of the drum. Upon this was placed a strip of "ticker" paper ½ in. in width, which was sensitized by being permeated with a specially prepared solution, consisting of 1.5 ozs. red prussiate of potash; .75 lb. ammonium nitrate; .50 lb. ammonium chloride and 1 gallon distilled water.

Upon this paper rested a steel brush. The brush and German silver surface of drum formed two terminals, shunted across grids of iron or German silver which formed part of the necessary resistance of the circuit. The potential difference between these two terminals was used to record the length of time current flowed before interruption, for the potential difference lasted only as long as the circuit was intact.

The effect of applying this P. D. across the prepared paper was to cause chemical decomposition of the solution and the iron of the brush, resulting in the production of a deep Prussian blue line, which ceased when the circuit opened. Now, by ascertaining the speed of the periphery of the drum and the length of line produced thereon while the circuit was closed, the interval of time which the blue line corresponded to—that is, the time required by the circuit breaker to open—could be readily calculated.

The method of determining the number of revolutions of the disk per minute was by means of a specially adjusted, firmly fixed, short piano wire, which made contact each revolution with a copper wire

* Tests on Automatic Circuit Breakers, *Electrical Engineer*, July 15 and 22, 1897.

attached to the drum. This made a distinct tick at each revolution. It was found that best results were obtained by having one operator hold the brush on with proper tension during the time that the record was being made, while the other counted the number of revolutions per minute.

To avoid error due to the variation of speed during the counting of revolutions, the count of seconds was started first, then at the middle point of the count the main switch was closed and record made, the count of the number of revolutions continuing through the remaining half of the seconds. By this means the element of error was due to the speeding up or slowing down of the motor during the period of counting.

There is a time factor which enters into all circuits. The time factor depends on the self-induction in the circuit and the value of the current thrown on. A current will not rise to its full value, $\frac{E}{R}$ immediately if there is self-induction, and the greater the self-induction the larger will be this time lag of the current. In the tests it was found that in all cases the time lag was so small that the current rose to full $\frac{E}{R}$ value before the circuit breaker opened. In one case we short-circuited a 115-volt, 200-kw generator through the circuit breaker. The current indicated by our galvanometer was 1300 amperes, the total resistance in circuit being presumably nearly .1 ohm. With this resistance the value of the current would be $\frac{E}{R} =$ 1150 amperes.

It was thus conclusively proven that, contrary to the results of previous investigations, a galvanometer for the purpose of measuring the value of the current in such a circuit is unnecessary.

A circuit breaker does not prevent the current from rising to its full value even though, as will be seen later on, it does open faster in proportion as the overload is greater.

Another use for the galvanometer was presented immediately. It was employed instead of an ammeter to measure the current when the resistances of the circuit were being adjusted for permitting the desired overload current to flow during each observation. The advantage in its use was that the current was on but momentarily, whereas with an ammeter as the current reading device, an appreciable time must elapse for the needle to come to rest and the reading be made. With large currents such as were used, the employment of an ammeter as the measuring instrument would interfere with all other tests being made by other students using the same dynamo.

The galvanometer was calibrated by adjusting the current in circuit to any value and reading that current by an ammeter; then the main circuit was opened by use of a circuit breaker, producing thereby through an induction coil, a kick of the galvanometer proportional to that current.

In the calibration it was found that the curve between current as ordinates and kick as abscissæ formed a straight line.

It was also found that a water resistance barrel was the only suitable form of resistance to use. Other resistances, such as metal grids, do not keep constant long enough to enable the two readings of ammeter and galvanometer to be taken with proper accuracy.

The galvanometer circuit was so connected that when current in the main circuit was switched on, the e. m. f. produced by the induction coil produced a kick in the galvanometer proportional to that e. m. f. which, in turn, is proportional to the current flowing in the main circuit. An arrangement was made whereby the small galvanometer switch was opened by the circuit breaker, but this opening effected before the circuit breaker actually opened, and therefore before the circuit was interrupted. Hence a kick was obtained corresponding to the "making" of the maximum current and no back kick due to the breaking of the circuit.

The speed of opening of a circuit breaker depends upon mechanical construction. The time required for the plunger to trip the releasing latch depends upon the magnetic force which is exerted to suck the plunger up into the solenoid of the circuit breaker. This depends upon the value of the current in the solenoid. Now, it is seen that the speed of opening depends upon two factors, one a constant depending upon mechanical construction, the other varying with the current. By assuming a value for the constant of mechanical construction and subtracting it each time from the total time of opening, the following tables show that the product of the remaining time and the current is for each setting approximately constant, the time of opening varying inversely as the current. Each reading in the tables represents an average of four observations:

CIRCUIT BREAKER *A*.

Constant of Mechanical Construction, K = .012.

Setting Amperes	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec. — K.)
75	77	50	.076	8.55	7.43
75	77	75	.069	9.05	7.48
75	77	100	.064	9.60	7.80
100	102	50	.086	12.90	11.10
100	102	75	.077	13.42	11.37
100	102	100	.071	14.15	11.80
125	125	50	.089	16.59	14.44
125	125	75	.073	15.92	13.34
125	125	100	.066	16.50	13.50
150	150.5	50	.085	19.18	16.43
150	150.5	75	.075	19.62	16.54
150	150.5	100	.067	20.02	16.50
175	175	50	.090	23.49	20.47
175	175	75	.081	24.65	21.13
175	175	100	.066	23.01	18.90

CIRCUIT BREAKER *B*.

Constant of Mechanical Construction, K = .005.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec.—K.)
60	59.5	50	.055	4.97	4.50
60	59.5	75	.049	5.12	4.62
60	59.5	100	.041	4.92	4.32
80	59.5	50	.055	6.54	6.00
80	59.5	75	.048	6.65	6.12
80	59.5	100	.042	6.68	5.92

CIRCUIT BREAKER *C*.

Constant of Mechanical Construction, K = .023.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec.—K.)
45	46	50	.076	5.13	3.58
45	46	75	.071	5.75	3.78
45	46	100	.069	6.30	4.14
60	62	50	.098	8.75	6.75
60	62	75	.084	8.75	5.41
60	62	100	.082	9.78	6.41
75	76	50	.103	11.56	9.00
75	76	75	.092	12.04	9.06
75	76	100	.083	12.45	9.00
90	90	50	.104	14.00	10.94
90	90	75	.087	13.96	10.08
90	90	100	.078	14.04	9.90

CIRCUIT BREAKER *D*.

Constant of Mechanical Construction, K = .02.

Setting Amperes.	Normal Opening Amperes.	Applied Overload Per Cent.	Overload Time of Opening Seconds.	Constant of Setting.	
				Amp. × Sec.	Amp. × (Sec.—K.)
45	44	50	.080	5.41	4.05
45	44	75	.072	5.67	4.10
45	44	100	.061	5.54	3.69
60	60	50	.091	8.15	6.39
60	60	75	.077	8.11	5.78
60	60	100	.073	8.73	6.36
75	75	50	.092	10.38	8.10
75	75	75	.082	10.79	8.14
75	75	100	.076	11.40	8.40
90	90.5	50	.094	12.61	9.99
90	90.5	75	0.84	13.23	10.08
90	90.5	100	.074	13.38	9.72

The constant of mechanical construction, K, is different for each circuit breaker, but is a constant for any one. It depends upon the strength of the spring which opens the switch and the inertia of that switch arm.

The expression, current multiplied by time of opening minus a constant equals a constant, is approximately true for any setting of the breaker only when the curve of magnetic density in the plunger is a straight line.

The equations which were found to satisfy the results obtained were as follows: For current breaker A, $I \times (T - .012) =$ constant. For circuit breaker B, $I \times (T - .005) =$ constant. For circuit breaker C, $I \times (T - .023) =$ constant. For circuit breaker D, $I \times (T - .02) =$ constant.

Hence it is seen that except for the constant time element introduced by the mechanical action of the spring, it is shown that the current × time factor is constant, which is what has been claimed by manufacturers of circuit breakers.

Electric Furnaces at McGill University.

Two electric furnaces were installed in the physical chemistry department of McGill University, Montreal. They are large enough to take a current of 100 amperes at 110 volts. The principal use to which these furnaces, with their immense heat of 3000 or 4000 degs. Centigrade, are to be put is the splitting up of compound substances into their component parts.

European Types of High-Tension Alternators—IV.

BY C. F. GUILBERT.

KOLBEN ALTERNATOR.

A Kolben alternator, shown at the Paris Exposition (Figs. 20, 21 and 21*a*), was direct connected to a Ghent tandem compound engine with Sulzer valve gear and deserves especial mention. The drops in this type of machine, as given in the table which will appear at the end of this series of articles, and which were obtained in a test of an identical machine installed in the Prague central station, are very small. Moreover, the characteristics and the section of the field conductor show that the minimum power factor can be much reduced or the apparent power augmented. This machine is one among the alternators with saturated poles, which possesses the greatest elasticity of power, and in the writer's opinion deserved a higher award at the Exposition than was received—a gold medal. This was the only alternator exhibited having laminated polar surfaces cast in flowed steel cores, though this kind of pole construction has been frequently used in Europe for some time past.

LIEGE ALTERNATOR.

The alternator exhibited by the Compagnie Internationale D'Electricite de Liege (Figs. 26, 27 and 27*a*), was driven by a Ghent compound tandem engine, and presents no point of particular interest except its winding. All of the armature coils—one per phase and per pole—are identical and are form wound and placed similarly to the armature coils of a direct-current machine. The exciter is supported on a shelf cast with one of the bearing pedestals.

CHARLEROI ALTERNATORS.

The alternator exhibited by the Societe Electricité et Hydraulique de Charleroi, consisted of two three-phase machines (Figs. 19, 22, 23, 37 and 38), one driven by a cross-compound Bollincks engine and another by a Wehyer et Richemond engine; and a single-phase machine (Figs. 30 and 31), driven by a vertical, triple-expansion Augsbourg engine. These machines were noticeable for their lightness and for the very complete manner in which the metal is usefully employed.

BROWN-BOVERI ALTERNATOR.

The Brown-Boveri alternator exhibited at Paris (Fig. 45) was direct-connected to a triple-expansion, horizontal Sulzer engine of the well-known standard type of the Winterthur firm. One of the features of this Brown-Boveri type is that the armature is carried by

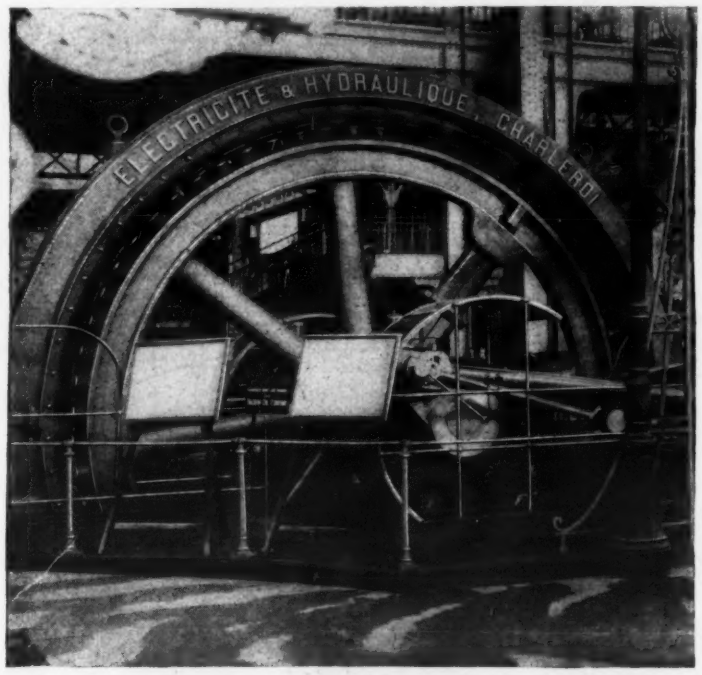


FIG. 19.—CHARLEROI ALTERNATOR.

two spider frames with trunnion rings cast on the bearings, a concentric position of the armature with respect to the field magnets being thus assured. This construction also facilitates repairs to the armature. The winding is disposed in such a manner that all the coils of one and the same phase are similarly placed. This machine, the saturation on which has a medium value, has an over-load capacity of about 20 per cent.

OERLIKON MACHINES.

The alternators exhibited by the Oerlikon Works were three in number, one of which was driven by an Escher-Wyss engine, another by a Sulzer Winterthur engine, and the third (Fig. 42), by a Pic-

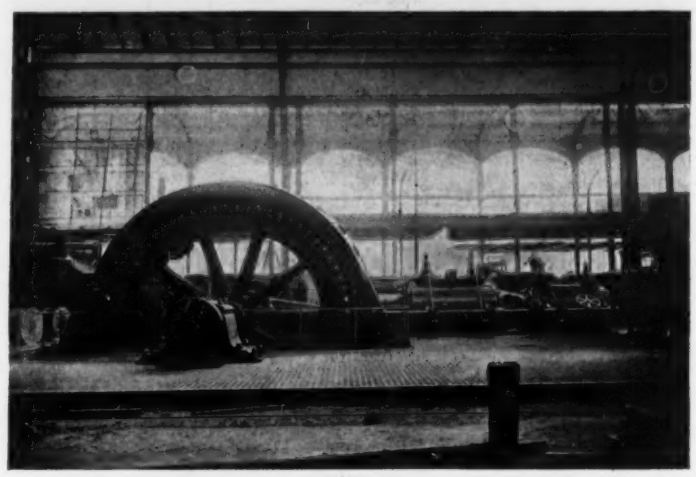


FIG. 21A.—KOLBEN ALTERNATOR AT PARIS EXPOSITION.

ard turbine. All three machines had laminated poles of low saturation. The alternator of 1375 volt-amperes capacity with a minimum power factor of .8 is the only one with alternate poles shown by this company (Figs. 34, 35 and 39). The armature is provided with a special means for regulating the air-gap, being supported on three foundation plates, two of which are supplied with double wedges and a screw for adjustment. The third plate, located at the bottom of the pit, supports the weight of the armature through the intermediary of two small jack screws. The over-load capacity of this machine is very large with respect to the margin allowed for excitation, but the

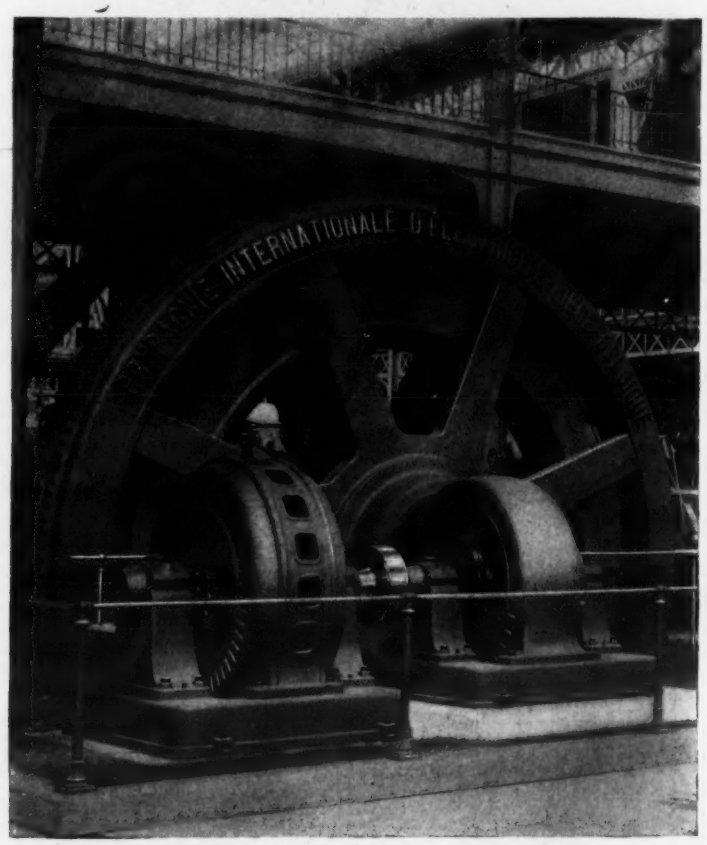
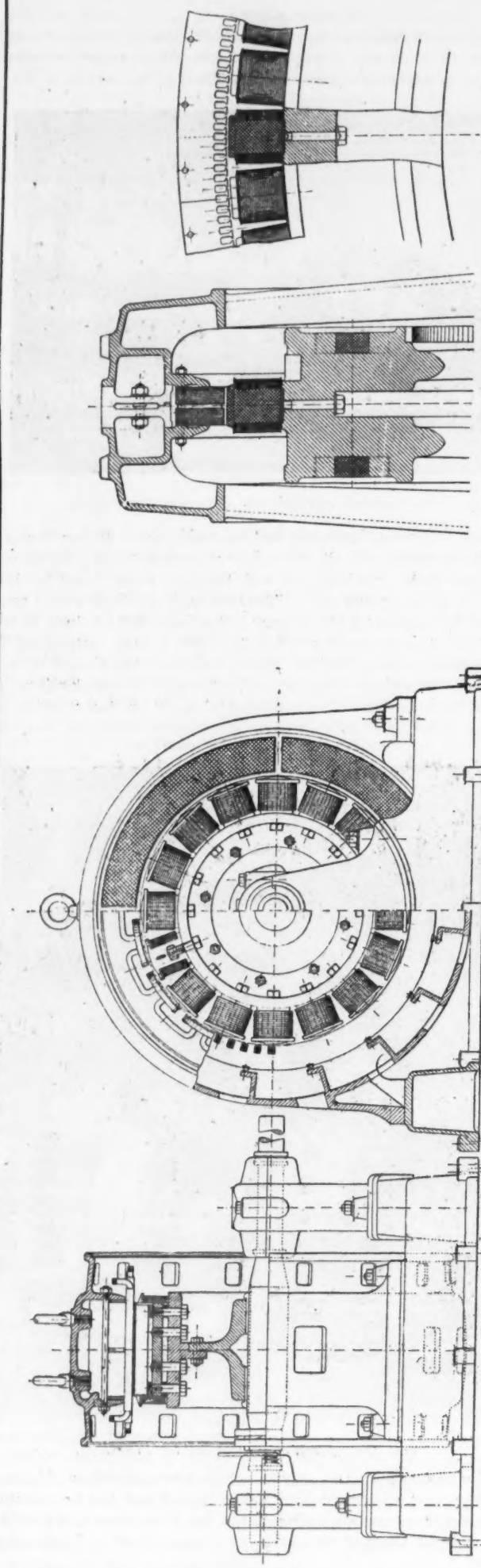


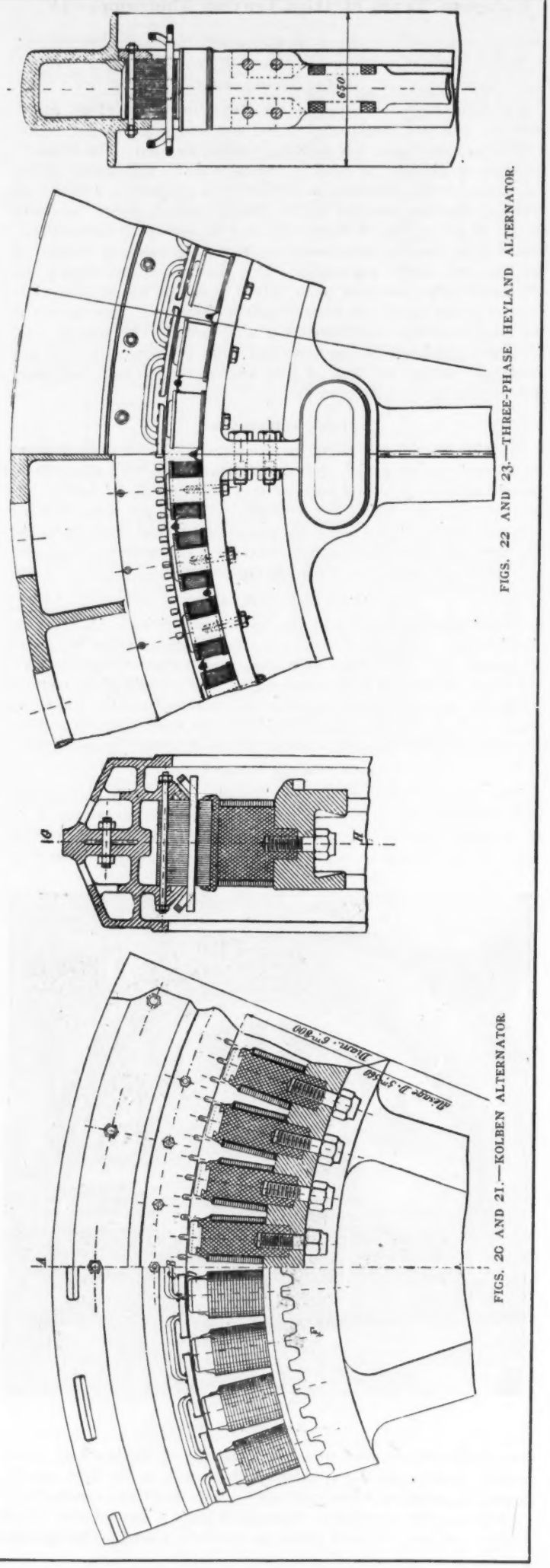
FIG. 27A.—LIEGE ALTERNATOR AT PARIS.

drop is considerable. An inductor alternator exhibited by this company (Fig. 44), was driven by a Sulzer engine and had an armature adapted for three-phase winding, but at the Exposition was provided with a special winding to enable it to operate as a single-phase machine.



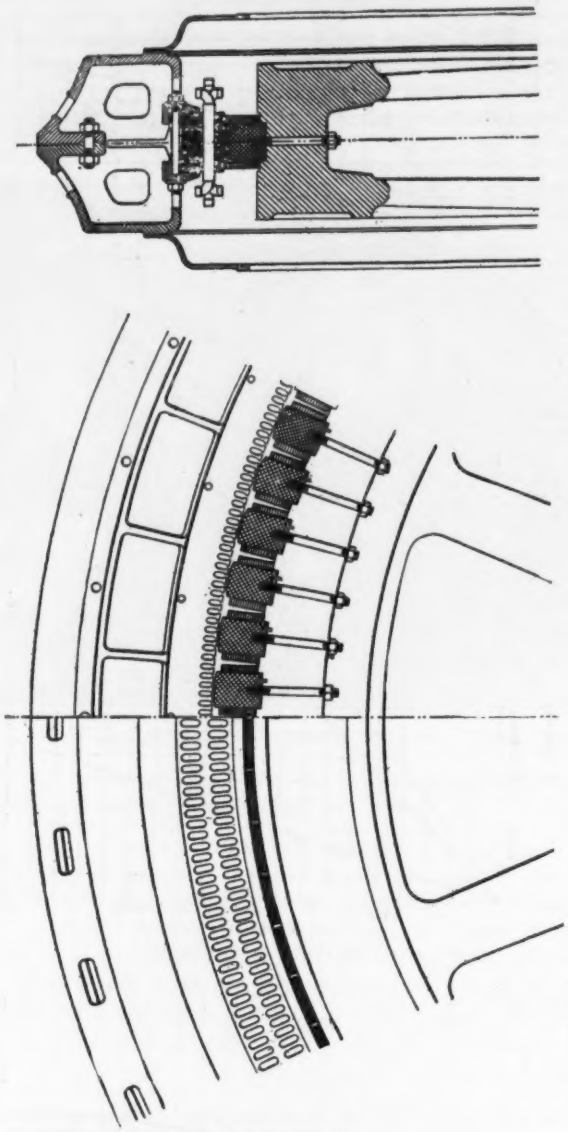
FIGS. 26 AND 27.—LIEGE ALTERNATOR.

FIGS. 24 AND 25.—THURY ALTERNATOR.

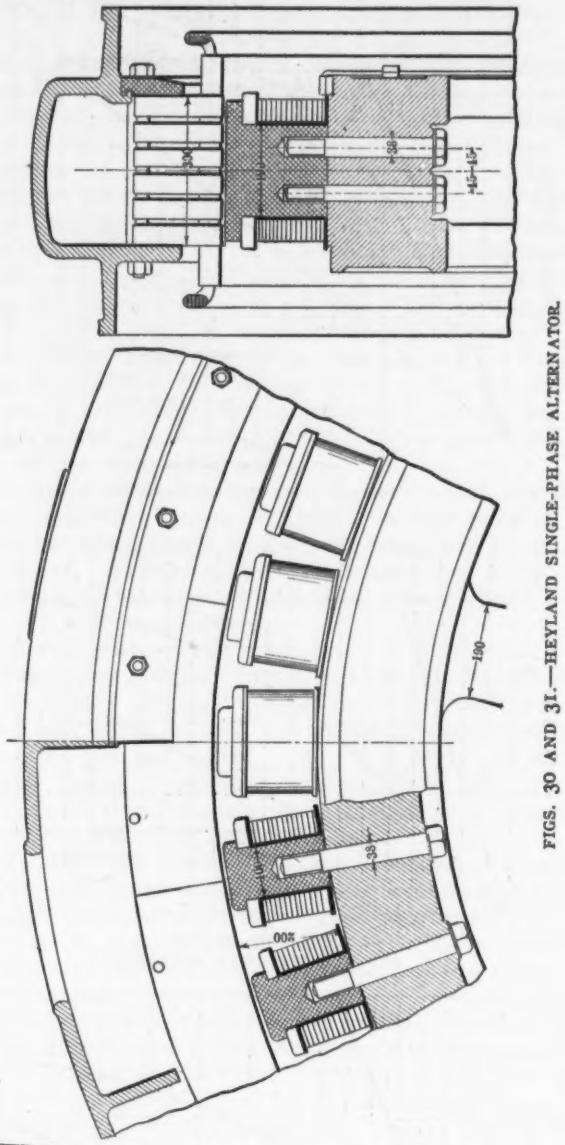


FIGS. 22 AND 23.—THREE-PHASE HEYLAND ALTERNATOR.

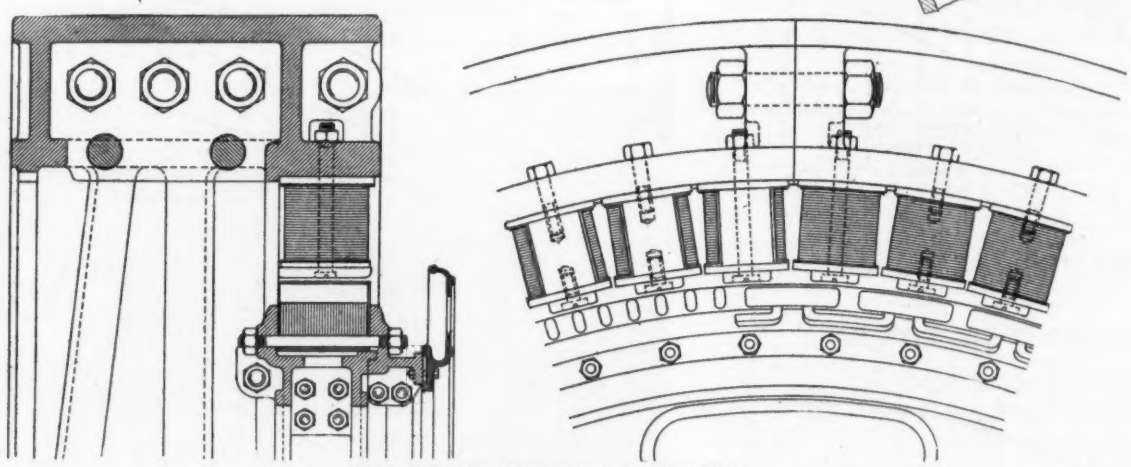
FIGS. 20 AND 21.—KOLBEN ALTERNATOR.



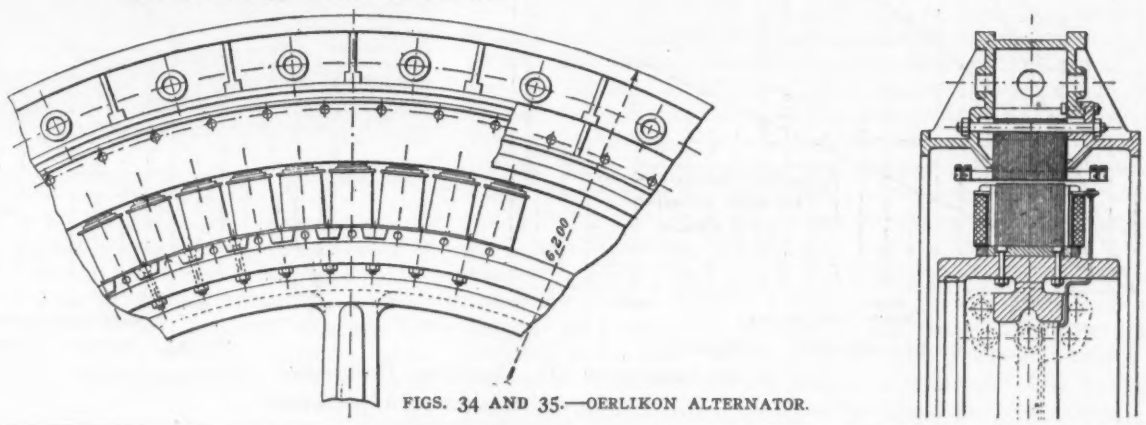
FIGS. 28 AND 29.—CREUSOT ALTERNATOR.



FIGS. 30 AND 31.—HEYLAND SINGLE-PHASE ALTERNATOR.



FIGS. 32 AND 33.—RIETER ALTERNATOR



FIGS. 34 AND 35.—OERLIKON ALTERNATOR.

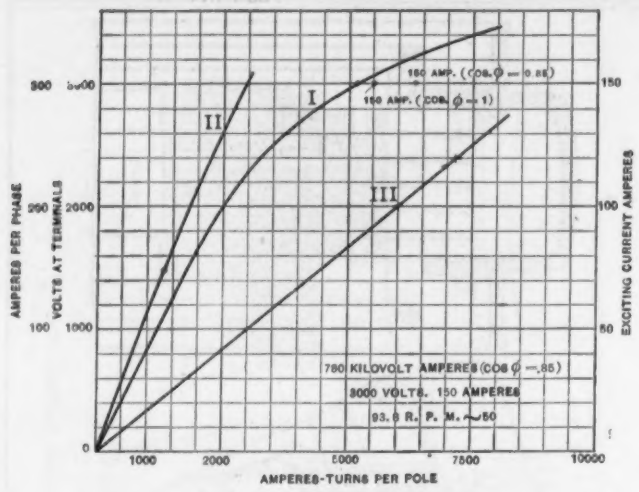


FIG. 36.—KOLBEN ALTERNATOR.

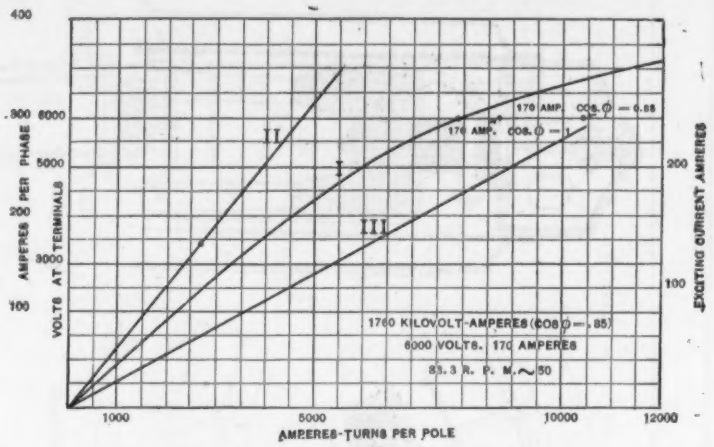


FIG. 40.—BROWN-BOVERI ALTERNATOR.

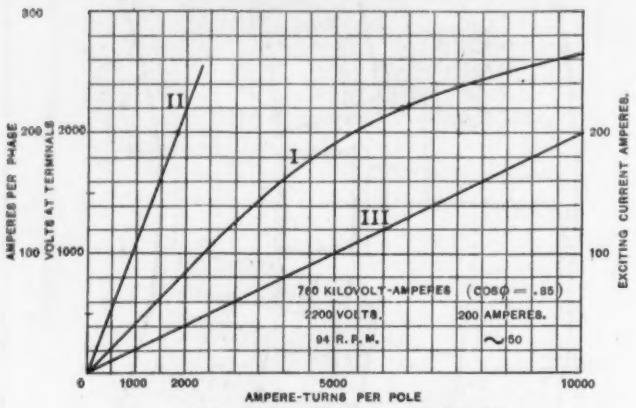


FIG. 37.—HEYLAND ALTERNATOR.

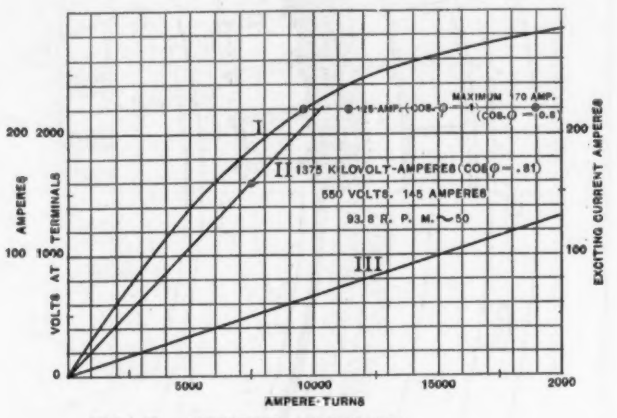


FIG. 41.—OERLIKON ALTERNATOR.

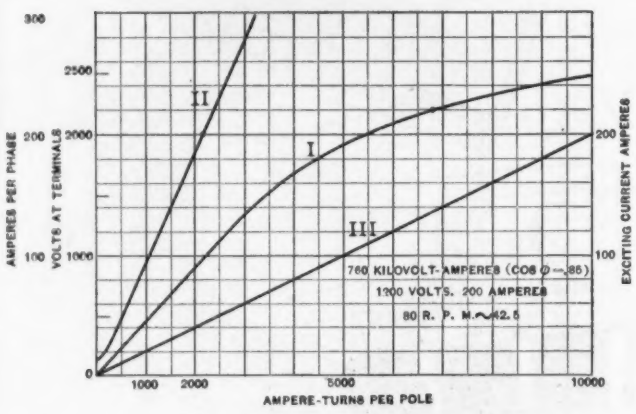


FIG. 38.—HEYLAND ALTERNATOR.

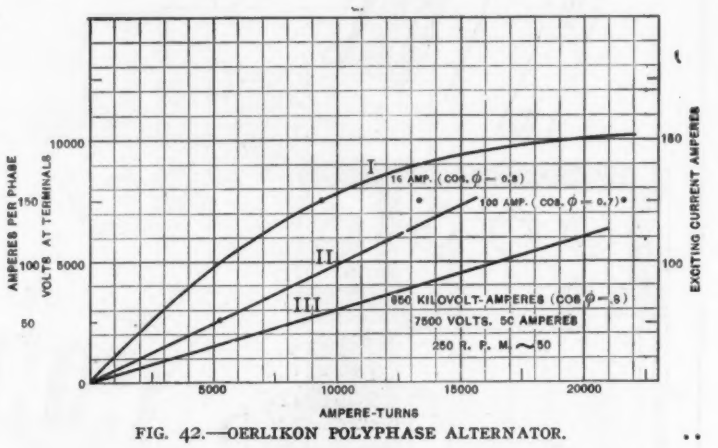


FIG. 42.—OERLIKON POLYPHASE ALTERNATOR.

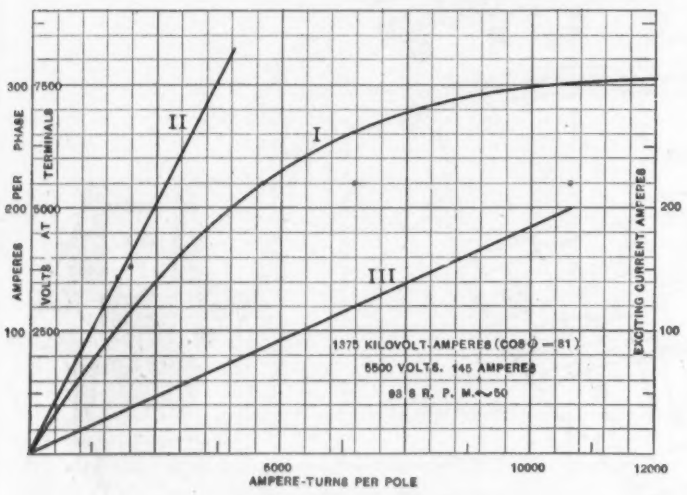


FIG. 39.—OERLIKON ALTERNATOR.

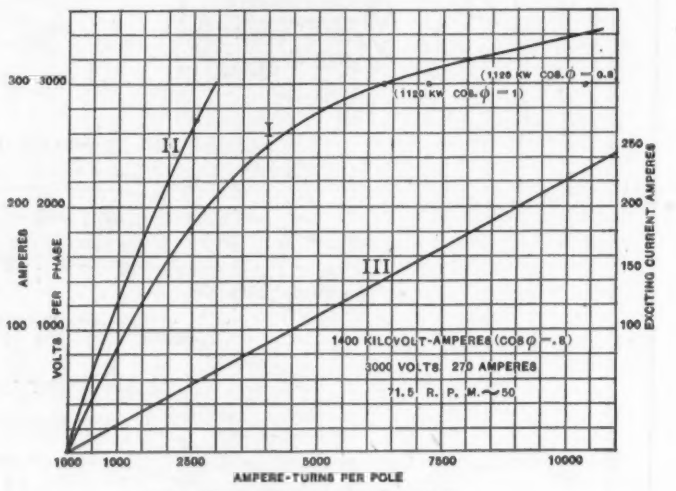


FIG. 43.—CREUSOT ALTERNATOR.

I.—No-load Characteristic. II.—Short-circuit Characteristic. III.—Excitation line.

CHARACTERISTICS OF ALTERNATORS.

RIETER ALTERNATOR.

The alternator exhibited by the Rieter et Cie., of Winterthur (Figs. 32 and 33), was direct connected to a tandem compound Sulzer engine, and was the only machine at the Exhibition having a fixed armature placed in the interior of the field—an arrangement particularly appropriate where it is desired to increase the flywheel effect.

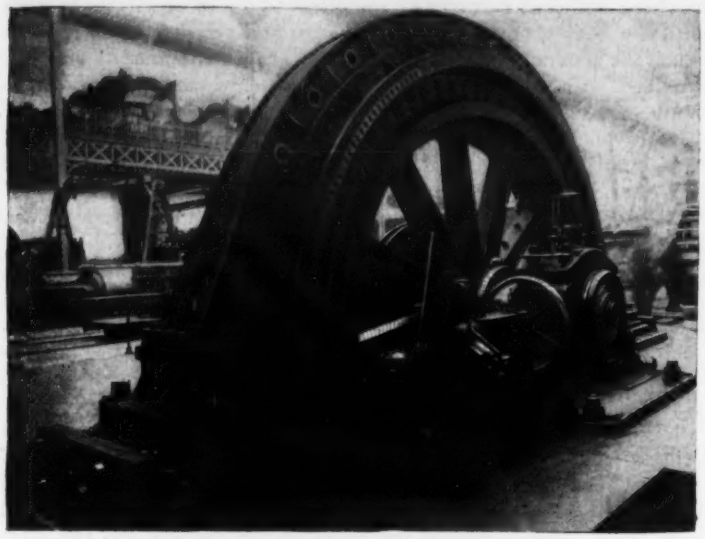


FIG. 44.—OERLIKON ALTERNATOR AT PARIS EXPOSITION.

The frame of the armature could be turned in pedestal bearings so as to make any part of it accessible.

THURY ALTERNATOR.

The Thury alternator exhibited at Paris (Figs. 24 and 25), was driven by a vertical Escher-Wyss engine, and was one of the two two-phase machines shown in the Exposition. A feature of interest in this alternator consisted in radial grooves in the field poles analogous to those in certain direct-current machines, and having for an object, as in the latter machines, to reduce the armature reaction flux. The drop in this machine is quite small.

GANZ ALTERNATOR.

Schneider & Co., Creusot, exhibited an alternator (Figs. 28, 29 and 43), driven by a horizontal triple-expansion Dujardin engine, which, though a Ganz machine in design, differed in appearance from the

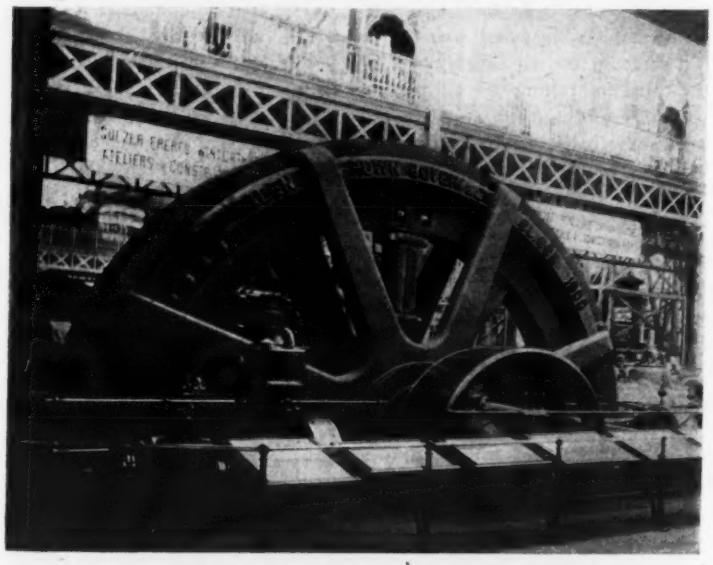


FIG. 45.—BROWN-BOVERI ALTERNATOR AT PARIS EXPOSITION.

Ganz alternators exhibited in the Hungarian and Austrian sections. All the coils of the same phase are similarly placed. In order to facilitate dismounting of the machine, the winding at the joints of the frame has been partially omitted. The fixed part of the machine comprises two half crowns assembled on a horizontal diameter and supported by two lugs fixed on the armature at surfaces slightly vertical, thus permitting the dismounting of the upper half crown in case of necessity.

Work of the Signal Service Corps in China.

It has been asserted and generally understood that the Japanese troops were first to enter Pekin with their telegraph field line on the famous "relief expedition." The report of the chief signal officer claims this honor, however, for the American Signal Corps, and after describing the preliminary stages of the work done by Col. James Allen to get an equipment from Manila to China and to Tientsin, he gives the following narrative of the course of events:

The conditions under which these operations were conducted in the field were most trying. They entailed not only marching as fast as the army and the construction of a telegraph line equal in length to the daily marches, but also the establishment of telegraph stations at night, their dismantling in the morning, and the dispatch of telegrams during a considerable part of the night. The difficulties were greatly enhanced by the fact that for days at a time the detachment was obliged to work without escort or any protection other than reliance on its own members.

Most unfortunately, this labor, exhausting at the best, was done under most unfavorable climatic conditions, the heat being so excessive as to frequently disable for hours the most energetic men of the Signal Corps. Many of the Chinese laborers were prostrated, and in one day two of them dropped dead from heat and overexertion.

Lieut. Stamford was alive to the necessities of the occasion, realizing that the nearest telegraphic force was two days behind him. This was the military telegraph organization of the Japanese army, which, being near home, not only had its full equipment, but also a force of 100 enlisted men and 20 or more army carts. As it was, all telegraphic reports of advance operations of the allied armies in the march to Pekin necessarily passed over the Signal Corps line. The occupation of Pekin was thus reported.

It is to be added that during the advance the first information as to the capture of Yangt-sun, on Aug. 6, was received from Major Scriven, Signal Corps, although his telegram of that day was delayed three days in transmission—doubtless owing to the demoralized and congested condition of the Chinese land lines between Chefoo and Shanghai.

In view of the trying and unfavorable conditions recited, it is a source of gratification that the Signal Corps detachment justified the confidence placed in it by General Chaffee and by the chief signal officer. Through the labors of Lieut. Stamford's men the American army carried the first telegraphic wire into Pekin, where the first telegraph office was installed in the house of Minister Conger.

Fortunately, this action permitted General Chaffee, in Pekin, to extend courtesies, in the way of transmitting telegrams, to officials of the British, Russian, French, German, Italian and even Chinese governments, and likewise to the press.

So strenuous were the labors of the enlisted Signal Corps men, both before and after their arrival at Pekin, that it was with difficulty that telegraphic work was maintained at Pekin, owing to the large number of operators incapacitated by sickness.

The Proposed German-Dutch Cable.

The *Deutsche Wochenzeitung* announces that Germany has come to terms with Holland with regard to providing the Dutch East Indies with a cable system which shall be free from British control. According to the project a main line will be laid to Shanghai, and thence branch lines will be laid northwards to Kiao-chau, eastwards to Japan and the United States, and southwards to the Indian Archipelago. The southern line will first touch land on the Bismarck and Caroline Islands. It will then take a westerly course, and passing through the Dutch Indies by a circuitous route so as to avoid any British possessions, will be brought to land on the North Natuna Islands, which are to form the terminal point of the Dutch Indies cable. The authorities of the Dutch Indies will lay the three following cables; a cable from the Natuna Islands to Pontianak, Billiton, Banka and Palembang, in connection with the land telegraph, which crosses the interior via Kalianda through the Sunda Straits to Anjer, and finally reaches Batavia; a direct cable between Palembang and Batavia, and a cable from Macassar to Amboyna. At the latter point Germany will resume the laying of the cable in order to take it to German New Guinea, where a junction will be made with the main line. It is believed that Germany will set about the work at once.

The Evolution of the Stock Ticker.

By Edward A. Calahan.

OPPOSITE the Stock Exchange, on the site of the present Mills Building, in Broad Street, New York City, there stood in 1867 an old building tenanted almost entirely by members of the rival stock exchanges, viz: "The Regular Board," the "Open Board," "Long Room" and the "Gold Exchange." A large room on the ground floor of this building had been divided by a partition. It had one main entrance from the street to a V-shaped hallway, from

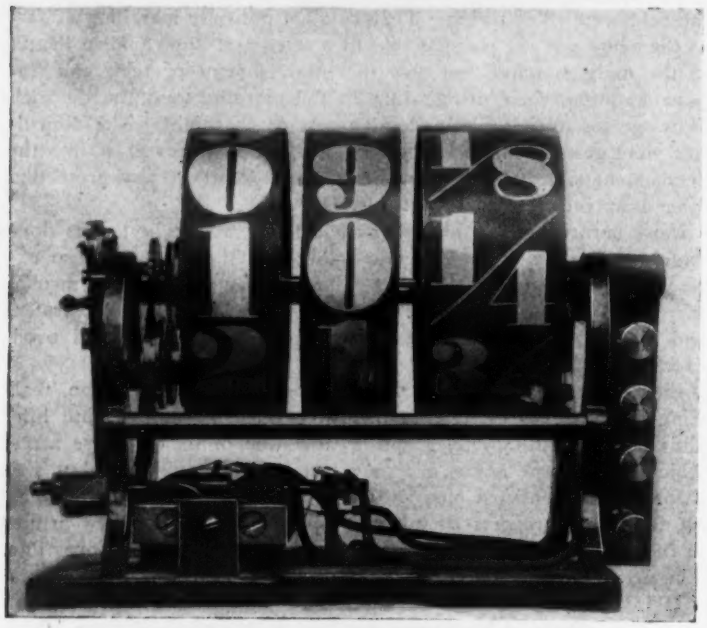


FIG. 1.—LAWS GOLD INDICATOR.

which entrances to the offices of two prominent broker firms were situated. Each firm had its own army of boys, numbering from 12 to 15, whose duties were to ascertain the latest quotations from the different exchanges. Each boy devoted his attention to some particularly active stock. Pushing each other to get into these narrow quarters, yelling out the prices at the door and rushing back again for later ones, the bustle made this doorway to me a most undesir-

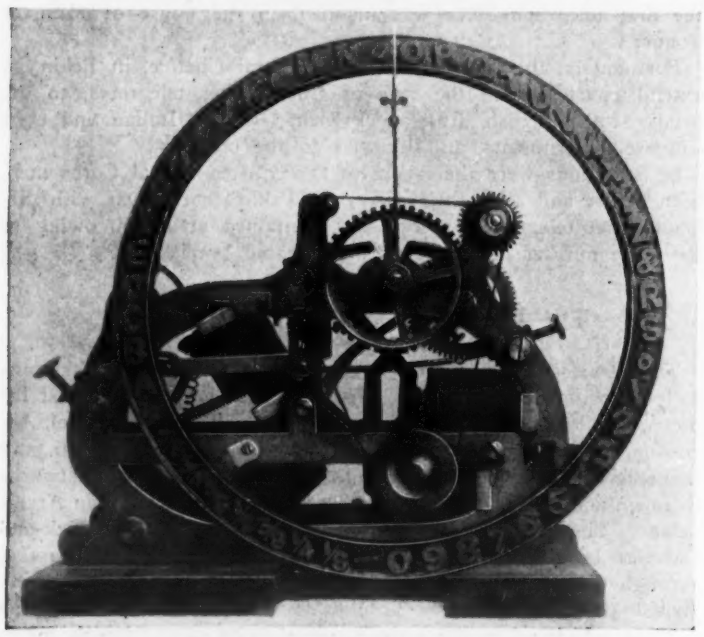


FIG. 2.—LAWS STOCK PRINTER.

able refuge from an April shower. I was simply whirled into the street.

This being my first experience in this locality during the active hours, I naturally thought that much of this noise and confusion might be dispensed with and that the prices might be furnished through some system of telegraphy which would not require the employment of skilled operators, who at that time were much in demand on the regular lines.

The conception of the "stock ticker"* dates from this incident. Gold at that time being at a very high premium, the fluctuations, which were quite frequent, were more interesting to the general public than were the prices of stocks. Yet the latter were often seriously affected by them.

Within a few weeks I devised an "indicator" for showing the price of gold at each fluctuation. This consisted of two dials, separately mounted, and each revolved by the direct action of an electro-magnet until the desired figures were brought to an aperature in the case in which the apparatus was enclosed. Each shaft containing its dial was provided with two ratchet wheels, one the reverse of the other. While one was used in connection with the propelling lever, this lever was provided with a lug to fit into the teeth of the reversed ratchet wheel on its forward movement, thus making it practically impossible for either dial to go by momentum beyond its limit.

On exhibiting this, I received encouragement to proceed. After constructing a few of these indicators, we found that we were anticipated in that field by Mr. S. S. Laws, who had secured the exclusive right from the Gold Exchange to send out the price of gold on visual indicators. While he had none of his indicators placed in a single subscriber's office, nor his lines constructed, we concluded to take up the more difficult problem of quoting stocks, which would be impracticable on an indicator or a series of indicators.

I at once transformed an "indicator" into a "stock ticker" making a printed record. This I accomplished by removing the two dials and substituting type wheels, and turning the movements face to face so that each type wheel could be impressed upon a paper tape in two lines. One wheel contained the letters of the alphabet and the other the figures and fractions and a few letters. It was then necessary to provide means for taking the impressions, inking the wheels and feeding the paper tape. The question then arose as to the form of the instrument; whether to construct it as a single wire instrument, which would be very complicated, expensive and unreliable, since it

FIG. 3.—ORIGINAL TRANSMITTER, FIRST CALAHAN STOCK PRINTER.

must of necessity be semi-automatic, or whether to construct it in the simplest possible form, using three wires, one for furnishing power for rotating the alphabet wheel, the second for the figure wheel and the third for taking the impressions from both wheels.

Many buildings contained from thirty to forty brokers' offices. The necessary lines or wires would be largely internal and therefore not subject to interruptions from the elements or other causes. This would be comparatively inexpensive when the complication in each instrument, if constructed on the single-wire plan, were to be considered. I concluded to adopt the three-wire system. Nearly eighteen years of practical work was an endorsement of such conclusion.

At this time there were no less than six general telegraph companies competing for the business of the brokers. Nearly every housetop in the neighborhood was cobwebbed with naked or uninsulated wires. I felt that to trust our system to the danger of contact with any of them would result in failure to our enterprise, and that insulated wires only should be used. I had much difficulty in impressing my associates with the advisability of resorting to this innovation (for such it was at that time). The difference in cost then was about 40 to 1 in outside construction. I received much gratuitous criticism from the Western Union wise heads for my extravagance. That company was not then interested in the quotation business.

Having thus developed the ticker, the Gold & Stock Telegraph Company was formed for the purpose of putting it into practical use. A working model in an office not connected with any lines or wires was not very convincing or alluring to the brokers. It was therefore with much difficulty that we secured the names of thirty-six members of the different exchanges as subscribers.

* The name "ticker" was given to this instrument by a lounger in a broker's office and for some reason was adopted by the public. The different companies advertising their "tickers" in the windows of barrooms and restaurants served to endorse this meaningless and most inappropriate name.

In December, 1867, we placed the first ticker in the office of David Groesbeck, and on the following day in the offices of Work, Davis & Barton, and Greenleaf, Norris & Company, and a few days later in the office of Lockwood & Company, each in the order of their subscription.

Before the fourth ticker was fairly in position our subscription list had increased to about 100 without any effort on our part. Demonstration was all that was necessary. At the end of the first year we had about that number of subscribers beyond our ability to place machines in circuit, although four manufacturers were working their shops full time on contracts to supply these tickers. The brokers were clamoring, many claiming that we favored members of one or the other exchanges. In consequence of such a demand we found it necessary to increase our modest capital from $200,000 to $500,000, paying 12 per cent on the latter. Within the first year the capital was again increased, this time from $500,000 to $1,000,000, and 10 per cent dividends were paid. With such immediate and astonishing success, it was scarcely to be expected that we would be permitted to enjoy the fruits of our labors without competition. Our first competitor was S. S. Laws, whose gold indicator plant we respected by not opposing it. He followed my plan of using the same movement for his type wheel that he employed in his indicator apparatus. It was a "three-wire system." One wire was used to furnish the necessary power for propelling the single type wheel forward, another to propel it backward, and the third for taking the impression and bringing into action a unison device which will be referred to later. The transmitter consisted of three ordinary Morse keys, one each for the advance, the retrograde and the press. He retired early from the

FIG. 4.—CALAHAN'S STOCK PRINTER.

field, selling both his gold indicator and his stock ticker plants to the Gold & Stock Telegraph Company. This company at once discontinued the latter, but continued the gold indicator plant until gold ceased to be quoted at a premium.

Edison next produced a ticker which was designed to use two type wheels, fastened together on the same shaft, and to be worked on one wire. A polarized switch was used to transfer the current from the type-wheel magnet to the press magnet, and vice versa. These type wheels, while fastened together, had a lateral motion on the shaft. They could at the desired time be moved, the letter wheel shifted directly over the impression pad, and alternately the figure wheel took that position. The pad was only large enough to take the impression of one wheel at a time. This was changed later. Instead of the type wheels conforming to the pad, the latter was made to conform to the type wheels. Lines were constructed to the offices of the members of the Cotton and Produce Exchanges. This ticker proved a failure from the beginning, and an additional wire was run to each subscriber's office, the polarized switch was removed, and it was therefore transformed into a two-wire ticker. As such, it was only a partial success, owing principally to inferior workmanship. It was replaced by a ticker invented by G. M. Phelps, which was vastly superior in workmanship, speed and accuracy, but more expensive and delicate, which may account for its limited use. It was expected to revolutionize the stock ticker business. It contained some of the Edison devices, among them the unison and the shifting devices. As both the Edison and the Phelps tickers were the property of the Gold & Stock Telegraph Company, they are not here classed among the competitors. After Laws, came Gallaher and many others who did not remain in the field long enough to be recorded. The next was the Manhattan, with a ticker invented by Mr. J. E. Smith. Its principal features were that the name of the stock and the price were printed in a single line from a single type wheel, and it was provided with a unison device. As that company had secured a number of subscribers in various lines of business without taking

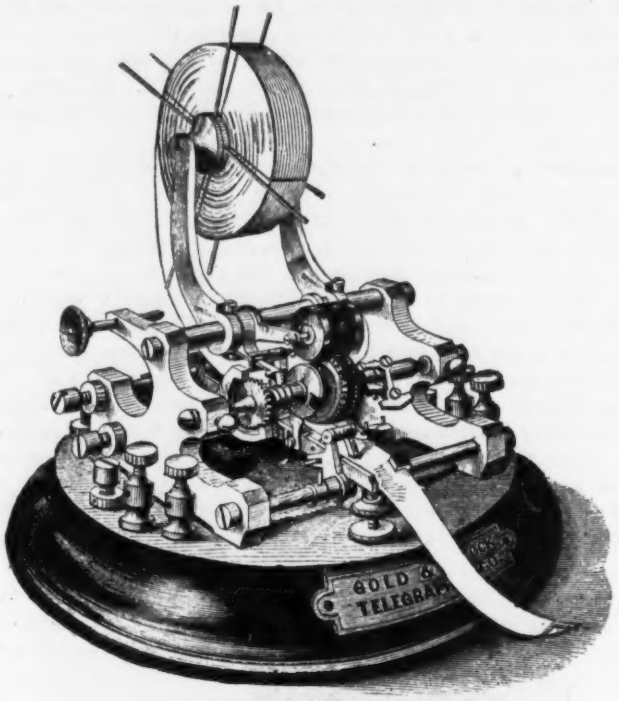


FIG. 5.—UNIVERSAL STOCK PRINTER.

any from the G. & S Company, it was absorbed by the latter company before it became a real rival.

The increased activity of the business on the Stock Exchange made it necessary for the Gold & Stock Company to increase the speed of its tickers. This was accomplished by substituting a star wheel for the reverse ratchet wheels. By this change each forward and back action of the lever moved the type wheel one point, while with the reversed ratchet-wheel device the type wheel was moved by the forward action only. An increase of nearly double the number of cells of battery, already numbering more than 1000, was necessary, the bat-

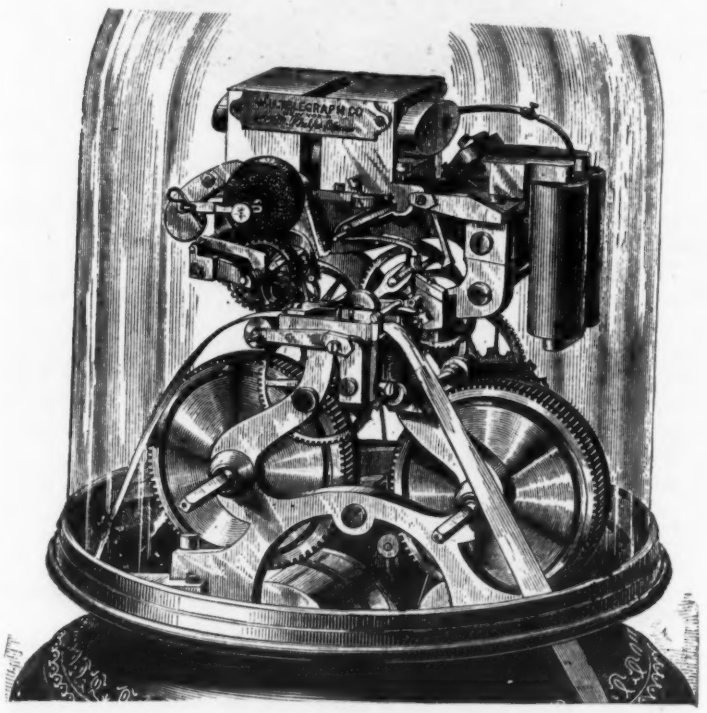


FIG. 6.—PHELPS STOCK PRINTER.

tery being the direct and only power used. The Manhattan was followed by the Commercial. They ignored all patent and other rights, and entered the field with a much superior apparatus, the production of Mr. Stephen D. Field. It became a most formidable rival. Two

type wheels were employed, mounted on separate shafts with a weight and clockwork for motive power. It was very rapid, and contained many novel features, and is to-day without a peer.

The competition was so sharp that the subscription price fell from $25 to $10 per month, while the actual cost to the Gold & Stock Company was $13 per month per ticker. This condition could not last indefinitely, therefore a suit was brought against the Commercial Company for damages caused by infringing the Calahan patent, and a judgment was rendered in favor of the patent for $266,000. This patent having expired a few months later, the Commercial Company remained in the field.

The name of the stock and the price printed in two lines on the same tape became so popular with the subscribers that any single-line printer would not be accepted by them. This fact was well known to the Commercial people, who paid the penalty for infringement as above stated. Anticipating the expiration of the Calahan patent and in order to keep pace with the increased business of the Stock Exchange, and also in view of the Commercial Company's fine ticker, it was necessary for the Gold & Stock Telegraph Company to produce one which would be equal if not superior to all others. That company was the owner of numerous patents from which all the necessary devices could be assembled without fear of infringing any existing patent. Mr. Geo. B. Scott produced an instrument which was not only very rapid, but was in every way all that could be desired. Were it not for the rupture between the Gold & Stock Telegraph Company, and the New York Stock Exchange, the Scott

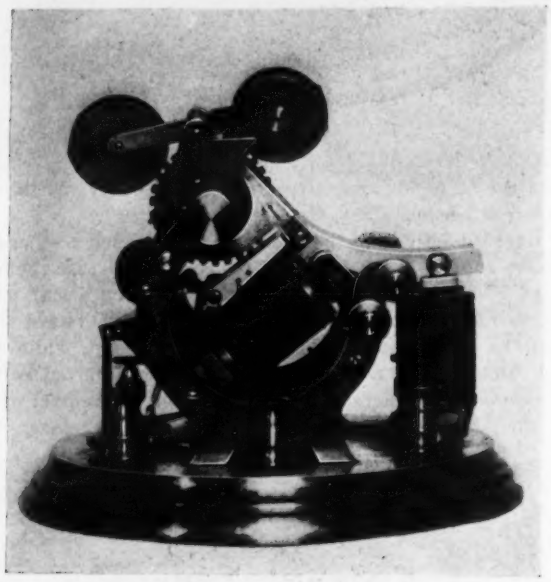


FIG. 7.—MODIFIED CALAHAN TICKER.

ticker would without doubt be the official recorder of the New York Stock Exchange.

The Gold & Stock Telegraph Company being so many years in the Stock Exchange felt that it was irremovable.. It refused to submit to what the general public would consider a reasonable request, with the result that it was practically expelled, and the defeated "Commercial" became its successor and the official ticker of the New York Stock Exchange. The Gold & Stock is now on the outside, taking subscribers from any but Stock Exchange members. The Consolidated Exchange followed in the same line, and adopted as their official ticker one used and owned by the Stock Quotation Telegraph Company to the exclusion of all others. It is a very neat, fast and reliable instrument, the invention of Mr. A. Wirshing. It has recently been improved by Mr. John Burry, who dispenses with the weight and adds, without diminishing the speed, a small and simple device called a self-winder.

A "ticker" at the present time would be considered as impracticable and unsalable if it were not provided with a unison device, either automatic or controlled by the transmitting operator. My first tickers were provided with neither, and yet it was at least four years before such an attachment was made. In my original tickers the shaft of each type wheel extended slightly outside the frame. A small pointer was inserted in this shaft, and a slot was cut in the frame. When both together, they corresponded with the zero point on the type wheel, and with the transmitter. The same on the other shaft. When from any cause one of the wheels was thrown out of correspondence with the transmitter, a subscriber or office boy would bring the points to unison by hand. This means appeared to be satisfactory.

Mr. Henry Van Hoevenbergh invented a special device which was very successful. Briefly described, if one of the type wheels fell behind, the other wheel would pick it up while passing and leave it at the zero point, and still go on its journey. The delinquent wheel would perform the same service for the other one under like circumstances. This being fully automatic, no time was consumed in bringing the whole system to unison as in all other devices, because of one ticker falling behind.

The first unison device on stock tickers was one used on the Laws printer. It was a crude and unsatisfactory piece of mechanism, and necessitated the doubling of the battery in order to bring it into action. It was short lived. The Edison unison comprised a lever with the free end traveling in a spiral or worm on the type wheel shaft until it met a pin at the end of the worm, thus obstructing the shaft and leaving the type wheels at the zero point until released by the printing lever. This device is too well known to require further description. It is not applicable to any instrument using two independently moving type wheels, but on nearly if not all other instruments will be found in use.

Exports of Manufactures.

No feature of the exportations of the calendar year 1900 has been more remarkable than that of manufactures of iron and steel. When the total for 1899 passed the $100,000,000 line much surprise was felt in other parts of the world, and the opinion was expressed at home and abroad that the high prices which prevailed in the beginning of the year would cause a reduction of these exports rather than an increase. This expectation has not been realized. On the contrary, the year 1900 made even a larger gain than did the year 1899, and brought the grand total of iron and steel, exclusive of iron ore, up to $129,633,480, or more than $100,000,000 in excess of the year 1890, when the total was a little above $27,000,000, and more than double that of 1897, when it was $62,737,250.

Almost every important article shows an increase in 1900 over any preceding year. Pig iron amounts in 1900 to $4,500,000, against $3,225,000 in 1899, and $2,500,000 in 1898. Builders' hardware shows a gain of about $1,000,000 over 1899, and $2,000,000 over 1898. Steel rails amount in value to nearly $11,000,000 in 1900, against about $6,000,000 in 1899. Electrical machinery, which is greatly in demand in all parts of the world, increased from $2,500,000 in 1898 to $5,225,000 in 1900. Sewing machines increased from $3,000,000 in 1898 to $4,500,000 in 1900, and typewriters from $2,000,000 in 1898 to nearly $3,000,000 in 1900.

The destination of the articles of American manufacture, and especially of our machinery, is literally to every part of the world. Our sewing machines, typewriters and scientific instruments go to Asia, to Africa and to the islands of Oceania; and what is more remarkable, they go to experienced Europe with all her facilities for manufacturing and her skilled workmen. Of the $6,788,000 worth of instruments for scientific purposes, including telephone and telegraph instruments, over $1,000,000 worth went to the United Kingdom alone, nearly $1,000,000 worth to France, and $500,000 worth to Germany. The United Kingdom and Germany each take over $1,000,000 worth of our sewing machines out of a total exportation of $4,500,000 worth. Over $1,000,000 worth of typewriters actually went to the United Kingdom, and $500,000 worth to Germany. Of the total exportations of builders' hardware, amounting in value to $9,782,402, over $2,000,000 worth went to the United Kingdom, nearly $1,000,000 worth to Germany, about $500,000 worth to France, and another $1,000,000 worth to other parts of Europe. Of the $10,895,416 worth of steel rails exported in 1900, over $1,000,000 worth went to Europe and nearly $4,000,000 worth to British North America.

Platinum vs. Copper.

The London *Daily Mail* is authority for the marvelous statement that the British Post Office authorities are considering the use of "platinum" as a substitute for copper! Fortunately "it has been practically decided not to use plantinum wire unless some means can be found to toughen it." Wonder if the *Mail* means "aluminum"?

Electrical Illumination at the Beginning of the Twentieth Century.

We brief below a lecture by Dr. Louis Bell on "Electric Illumination at the Beginning of the Twentieth Century," given at the station of the New York Gas & Electric Light, Heat & Power Company, Duane Street, New York City, before the New York Electrical Society, on Wednesday, Jan. 30, 1901.

In his opening remarks Dr. Bell said he would not speak of the science of electric lighting, but rather of the art of electric illumination. The art has been as much neglected, perhaps, as the science has been cultivated. He did not propose to waste any time in explaining the doctrine of the electric current, which he would take for granted, and take the appliances which we have for granted, and try to briefly explain what we can do with them in the way of getting illumination, which is, after all, the object for which the whole science of electric lighting has been developed.

To begin with, there is generally a good deal of misconception as to what we want by artificial illumination. There are two radically different doctrines, one may say, although they have not been formulated as doctrines, with regard to electric lighting and to artificial illumination of all sorts. One is that when we do artificial lighting we must try to vie with Nature herself, beat Old Sol at his own game. The other recognizes some of the limitations which finite intelligence and finite resources have imposed upon us, and goes at the subject of illumination, not as rivalling the illuminants of Nature, but merely as furnishing such amount of light as we actually need for some useful purpose. Our grandfathers, or great grandfathers, as it may be, did all their reading by the light of the tallow dip, save and excepting such of them as rose to great fame and did their reading by the light of pine knots, which was considered a sign of great genius for many centuries. These two views of electrical illumination have come from, on the one hand, a lack of comprehension of illuminants, and on the other hand, from a realization of what the actual conditions are when we attempt to furnish artificial light.

To begin with, at the present time it is safe to say that more illumination fails from being too bright than from not being bright enough. By too bright is meant too intense, as will be presently shown. The eye is a very curious optical instrument. Helmholtz used to say it was one of the worst optical instruments with which he was acquainted; that if an instrument maker had sent him such an instrument so badly constructed with reference to all scientific principles as the human eye, he would send it back, with thanks. Nevertheless, it has one peculiarity, one power, which is the basis of all our attempts at artificial illumination, which makes it possible, practically, to get artificial illumination, and that is the human eye can work over a tremendous range of brightness and still do its work effectively. We can read in brilliant sunlight, or by the light of a single candle, with fair comfort in both cases, although the candle is nearer than the sunlight. It makes comparatively little difference whether we read by the light of one of these arc lights or a single candle, so far as comfort goes. For other purposes the arc light is very valuable, but the eye itself gets along very comfortably, even when the amount of light is considerably reduced. That comes from the expansibility of the iris of the eye, widening or narrowing the pupil, in accordance with the demands of the occasion. Cats, bats, owls and all nocturnal animals have a tremendously expansive pupil, as you know; the cat's ranging from a mere infinite narrow slit to a full and wide pupil, as night comes on. An eye contracts ten or a dozen times less than its maximum dimension when a brilliant light comes on. As the light increases the pupil contracts; as the light decreases the pupil expands, letting in more light, and so enabling us to work satisfactorily with all sorts of artificial light.

Think, for a moment, what would happen if we had to have the equivalent of daylight to do our work, or have our pleasure, in the evening. It would be substantially impossible to furnish the equivalent of daylight, except with an enormous number of arc lights. Fortunately, the eye is so constituted that, provided we work within a fair range of illumination, we get along very well; and that, moreover, enables us to produce some of the most useful effects which we get from artificial illumination.

Whatever the source of illumination, there are some fundamental principles we must not forget in trying to do artificial lighting. The first is that the source of lighting ought to be unobtrusive, and, if you stop to think of it, that is the direction in which most artificial lighting errs. Instead of the source being unobtrusive, it is obtrusive, even unpleasantly so, and instead of helping the vision, often hinders it, for the reason that a bright point of light in the field of vision causes the pupil to shut up and protect itself and lessens the amount of light entering the eye, so that one cannot see with anything like the convenience which the amount of light would indicate. Excessive brightness of a particular spot is a thing to be avoided in all illumination. That is the reason for globes enclosing the lamps. The eye sets itself as regards the width of the pupil, as regards the effective aperture through which light falls on the retina, approximately to suit the brightest point in the field of vision, and as a result of that a very bright light dazzles the eye, and makes it extremely difficult to see objects which are not given bright illumination and causes trouble. Any one driving along a street or road, particularly in the suburbs, particularly where there have been shadows, on a road illuminated by electric lights, realizes how difficult it is to see beyond them. At the time we had the towers, with large lights, at Hell Gate and along the entrance to the Sound, there was constant complaint from the pilots of various boats that the lights bothered them. At that time the persons who put the lights there turned up their noses and said, "That cannot be; we are giving you fine illumination." So they were, but they were giving it from radiants so bright that the eyesight of the pilot was somewhat dazzled, the pupil contracted, and light coming from objects beyond and around, not equalling in brilliant illumination the lights in question, did not make sufficient impression upon the eye; in other words, you cannot see across a brilliant light.

A very little experience with the arc light convinces us that, although it is a magnificent light, the light is unsatisfactory because it gives too much light in one place. The increase in brilliancy in arcs of that character is enormously great. It amounts to, say, 30,000 to 50,000 candle-power per square inch of radiant surface, and that is a brightness of which it is really hard to form any conception. Imagine, if you can, 10,000 candles concentrated in the flame of a single candle, and you get some idea of the intrinsic brilliancy, the dazzling rays, that proceed from an unshielded arc light. Anything of that kind is simply bad illumination. It may be an extremely good light, but for illuminating purposes it is unsatisfactory, except in certain rare cases where, as in some of the early arc light experiments, the lights were put so high they would be out of the field of vision. Under these circumstances, when the rays would not fall directly on the eye, one could get along comfortably with the bright lights. On the other hand, the lights were put so high that the actual illumination from them was much reduced, so that one may say that the unshielded arc light has no place whatever as a general illuminant. There are cases where it is very valuable, but for general purposes it has been, as you see in this city, superseded by arc lights enclosed, not in one globe only, but two, with the inner globe immediately surrounding the carbon.

The intrinsic brilliancy of the arc light is the highest artificial brilliancy with which we have to deal. We have all the way from 20,000 or 30,000 to 50,000 candle-power per square inch in some portions of a very bright arc. Some estimates have run as high as 100,000 candle-power per square inch of radiant surface. The calcium lights, with which we were familiar as bright illuminants, have only 5000 candle-power to the square inch, while the ordinary incandescent light has only a matter of about 200 candle-power to the square inch. And even that is too bright. If you will look at it intently for a moment, you will see, when it is out, that you will catch an after-image in the eye of that bright filament. The after-image is a symptom of what may be serious effects on the eye if long continued. As a result, one can safely say that even the ordinary incandescent lamp, valuable as it is as an illuminant, is intrinsically too bright to yield entirely satisfactory results. That is the reason why people used to say so often—they are getting over it now—that the electric light was hard. What they meant by that was that it was too intense in its brilliancy; although giving an abundance of light, the brilliancy was too intense to give thoroughly satisfactory results as an illuminant. Better results are obtained from a smaller lamp of 8 candle-power against 16 candle-power in another, and provided with a ground globe. The result is that the brightest spot on which the eye has to dwell is very much less bright than the naked filament of the incandescent lamp. This brilliancy has fallen off, from being 200 to 250 candle-power to the square inch, to being, perhaps, a matter of 15 or 20 candle-power to the square inch. That means that the eye adjusts itself with reference to the brightness of the entire lamp, the central portion being the brighter, and the pupil does not close as far, and one can see almost as readily with one lamp as with the other. In fact, the smaller lamp with ground

globe is preferable, for the reason that the brilliancy being less, the pupil of the eye is wider, the effective aperture for the light used much greater, and the ability to read much greater, than it is with the very brilliant light, such as is given by the other lamps. In view of the automatic adjustment of the eye for the maximum brilliancy with which it has to contend, it does not matter much how it is done, so that the light is diffused, and lamps of that kind give a much more satisfactory illumination than lamps with naked filaments, in spite of the fact that the grinding of the globe cuts off from 25 to 30 per cent of the total light, but the 70 to 75 per cent left is enormously more useful than the original 100 per cent, because the intrinsic brilliancy is lower, so that the eye adapts itself to the more favorable condition.

Another fundamental point in illumination, which is sometimes forgotten, and which is really important, is its direction. One would suppose at first that it would not make any particular difference what way light fell upon an object which is to be illuminated; whether you got it horizontally from the side, whether you got it from below or from above, yet, in point of fact, it has been found by long experience that light from above is much more useful than light from the side, or, particularly, from below. This is probably due to the fact that the eye, through the many centuries of its development in man, has gotten habituated to getting sunlight from above, rather than light from below. It is a well-established fact that light which comes from an abnormal direction into the eye is sure to produce fatigue in one way or another. For example, light reflected from snow is peculiarly severe and often produces a species of inflammation resulting in snow blindness. Not because of its great brilliancy, for it really is not any brighter than the sunlight, nor nearly as bright, but because it comes upward from the snow, entering the eye from an unfamiliar direction, and probably concentrating its strength on that part of the retina less able to bear that particular sort of pounding from a brilliant light. It has been found that blacking the lower eyelid with burnt cork will stop the development of the snow blindness. You cut out the ground light which comes from below and remove the principal cause of the irritation. So there are two things to be specially considered; first, the maximum brilliancy of the illuminant should not be very great; it should be rather moderate; it should not be obtruded on the eye, and the direction should generally be downward and not upward.

The foregoing leads to the value of diffused lighting. Anything like diffusion of light means there will not be any one particular point which is very brilliant. The brilliancy will be rather moderate. At the same time an enormous amount of light can be successfully diffused in practice, and on diffusion we depend for some of our most valuable results in illumination. You can easily get an idea of the amount of the diffused light in any room by a simple experiment; that is, by turning out the lights which are available, and then shielding yourself from the only source of light which you have left, when you will find, in spite of being in the shadow, considerable light will still be manifest all about you. A room with white walls will give two or three times the effective illumination, with the same radiant, as a room which is painted in dark colors. A white painted surface is the very best diffuser of light. A white surface will diffuse from 60 to 80 per cent of the light which falls upon it. The light shades of yellow, almost as much. The distinctly yellow shades are also admirable for diffusing light. Then come the shades of red and orange of various kinds. Then come the light blues, and, last of all, the very deep blues and the greens. A dark green is perhaps the worst diffusing surface that can possibly be found. A room light in color can be successfully lighted by diffusion alone, where there is no direct radiation falling upon the eye at all. Sometimes it is a very excellent scheme to avoid too brilliant radiance, also to get a correct direction for the illumination, by depending entirely upon diffusion. Diffused light is apparently not as efficient as the brilliant light you get from an unshaded arc. It takes, undoubtedly, a great deal more of energy to give an equal amount of light in candle-power; at the same time it is a question whether lights supplied in that way consume the same amount of energy as a single arc light would to give the same illumination in the room. It is safe to say that the diffused light will give a much better illumination in spite of its lessened gross amount, on account of the fact that the light comes from the direction which is most useful, and is faintly toned to a pleasant color by the slight tingeing of the ceiling.

Color is a matter of great importance to illumination, for two reasons and in two particular ways. In the first place, the color of the light which we are wont to receive is not white; it averages a rather yellowish white. We sometimes think it necessary to obtain extreme whiteness of illumination. An illumination of normal color, that is to say, a somewhat yellowish white, is the one to which we are all used, and by which we are wonted to judge the colors of objects about us. If one were judging colors, exclusively, the particular kind of light you would want would be daylight, or as close an approximation of it as could be obtained, so that we find in order to get a correct judgment of color it is sometimes necessary to have a clear white light, and that color we have to get practically by arc lamps. Deep colors are always unpleasant and entirely unsuited to any practical illumination. In general, it is safe to say you cannot trifle with the color of your illuminant without producing disagreeable results; it makes no difference what the exact shades are. It is very desirable to confine one's self in the use of colors in illuminants to colors to which one has became habituated—that is, white or yellowish light. A light derived from shaded arcs placed above us is not as pleasant as the cornice light I have just shown. Certain colors of light are associated with certain things in the theatre. They always attempt to get moonlight by a curious shade of bluish-green, and it may be interesting to note that moonlight is greenish. That arises from the fact that moonlight, measured in candle-power, or in any terms by which we usually measure illumination, is a very weak light, and the eye loses its sensitiveness to red and blue before it loses its sensitiveness to green. As the light fades out toward the sunset, just as daylight is merging into darkness, one's judgment of color gets warped and twisted by the faintness of the light. Reds and blues lose their brilliancy, and so when the moonlight comes on, there is actually left a preponderance of greenish rays, which are mimicked on the stage by putting the proper shade of green before the projector.

Practically all our sources of light at the present are incandescent solids of one sort or another. The flame is merely the aggregation of white hot, yellow hot or red hot particles of carbon. The incandescent filament is merely a filament of carbon heated red hot, or white hot, as the case may be, by the current. In the case of the arc lamp we have the same thing, the radiant point there being the crater of the arc at the ends of the carbon, which are heated to a very high temperature indeed, and are brilliantly radiant. It should be borne in mind that the temperature of the flame, or the temperature of the radiant matter, is the thing which largely determines its color. A piece of iron heated moderately is red hot. After a bit it gets nearly white hot, and yellow hot, and finally it comes to a dazzling brightness, or whiteness. The same is true of any incandescent solid. We find certain oil lamps give a distinctly orange tinge; we find candles giving a pronounced yellowish tinge, with much red, and the gas lamps give a yellowish hue, with less red. Finally, the incandescent lamps, when they are thoroughly energized by the current and heated extremely hot, give a light which is almost pure white—as white as the arc; and the arc lamp, which has a higher temperature than all the others, gives a light which is distinctly white or bluish white.

It should be borne in mind that in incandescent lamps the question of color has not anything to do with the amount of light; simply the temperature of the filament which gives the light. For instance, take 5 incandescent lamps of precisely the same candle-power (16), all working on the same circuit, with the same voltage; yet of the one having its filament at a higher temperature if near the others on a fixture nine persons out of ten would say that is the brighter lamp, whereas it may not be as bright as the others. The color in the lamp is simply a matter of the temperature which it carries, and with a given number of inches of filament in a lamp at the same temperature you will get the same total light in every case. It may be distributed in one way or another, but the candle-power of the lamp really means so many inches of filament at such a temperature, the filament being of a specified size. The ordinary lamp, as used in practice, gives a bright, clear, slightly yellowish light, but, on the whole, it is a very satisfactory color for general purposes.

For the purpose of obviating the extreme brilliancy which we get from the unshielded light, the best general expedient is the frosted globe. There are many others which can be used successfully. The ordinary lamps which we have in commerce are either 16-cp lamps or 8-cp lamps. For example, if we place a 16-cp lamp of the frosted type, which gives a very excellent, soft, clear light, alongside a 16-cp naked filament lamp, the frosted light seems to give, and for practical purposes does give, by far the better light. The basis of all practical electric illumination in this country for interiors is the 16-cp lamp. It should always be used in a frosted form, or otherwise shaded, except in instances where indirect illumination is attempted, when it can be used with the naked filament successfully. The 8-cp lamp should be the favorite. Lamps of 32, 50, 100 and 150 candle-power are freaks. They are useful for some occasions, but not lamps to be

considered standard or convenient for the ordinary purposes of interior lighting. A 4-cp bare filament lamp makes a pretty light where a small amount is needed. The filaments in this lamp are delicate; indeed, so fine you cannot see them except in a good light, and the lamps have not the endurance of the 8, 16 and 32-cp lamps which are mostly used.

There are various ways of lessening the extreme brilliancy of incandescent lamps besides the use of the frosted globe. For example, we have lamps which can be toned down very materially by the use of shades, which produce, in not a very striking way, the same softening of the light which you get from the use of the frosted bulb. Various sorts and kinds of shades have been tried. These shades produce the same effect in toning down the apparent brilliancy that the frosted surface produces, and they, moreover, cut off less light than the frosted globe, and throw it conspicuously down or out sideways, as the case may require. This particular form is what is known as the holophane globe. There is a wide range in these globes. One is a diffusing globe, which throws the light out in a very satisfactory way, and produces precisely the same effect, as far as the eye is concerned, as the softening which you get from a ground or frosted globe; and, in point of fact, the loss of light in holophane globes, which are accurately cut, is only about 10 or 12 per cent., whereas in the ordinary ground globe it is a matter of 25 or 30 per cent.

The incandescent lamp, in spite of its usefulness in a general way, is, from a scientific point of view, unsatisfactory. You cannot get a high enough temperature in the filament to give the efficiency you want to get. Of the total energy which goes into a lamp, even if a 2-watt lamp, only about 5 to 6 per cent is returned to you as light. The rest of it goes into heat. The amount of heat radiated, in spite of the fact that the incandescent lamp is of all the ordinary illuminants the one that gives the least heat, amounts to 94 per cent or thereabouts of the total energy supplied to the lamp. The low efficiency is due purely to the fact that we cannot carry the filament at a temperature high enough to get the desired increase in efficiency. For the purpose of improving the efficiency there have been conducted experiments innumerable, but the best product of to-day are lamps running at 3 watts per candle or a little under, but they still have an efficiency of only between 5 and 6 per cent.

For better results than that we have to turn to other sources of illumination, and the obvious thing to do is to carry up the temperature of the illuminant to a point far beyond that which is found in the incandescent lamp. That is done in the arc lamp. At the temperature of the arc the carbon is vaporized very rapidly. Carbon, such as you find in the arc lamp, and in the filaments of incandescent lamps, is a substance somewhat volatile. It volatilizes somewhat like iodine, passing from solid into the form of vapor and softens and gets putty-like, so when incandescent lamps are carried to a high temperature the filament softens and rapidly breaks. As a result we have to look to the arc for help. There are small arcs made for the purpose of getting from lamps of moderate power an efficiency which we cannot get from even the best incandescents. Such lamps, in mere candle-power, may only be equal, in actual illuminating power, to these incandescents, but they seem brighter. The intrinsic brilliancy is greater, and the lamp itself appears to be a very bright object. It is very white, and it is very bright, as regards its intrinsic brilliancy, but the absolute amount of light is probably less than from the incandescents. Yet one of these lamps takes only the energy which would be taken by three 16-cp incandescents. The arc is a different kind of a flame. It is much more powerful as an illuminant, and is enormously brighter, owing to the fact that its efficiency, while perhaps not doubled, is probably as high as 9 or 10 per cent., as against 5 or 6 per cent on the incandescents. Lights of this kind could probably be shaded if they are going to be put where they would fall within the range of the eye. If you do not shade them, you will find the same trouble as with the incandescent lamp with naked filament.

Small arc lamps of this kind give more efficiency than the incandescent lamps, and for some purposes they may be quite useful. They are intensely white, giving a light by which it is possible to judge colors with great accuracy, and are highly efficient; but, of course, they are open to the objection to which all arcs of too great brilliancy are open. The brilliancy of the arc can be cut down in various ways, the most obvious one being by the use of globes. An arc light which would be intolerably bright, and entirely unsuited to practical illumination when unshielded, becomes, when hidden behind globes, a very satisfactory source of light, providing it is not thrust down where you have to look directly at it.

There is a difference, even in arcs, in point of brilliancy, and there again, just as in the incandescent lamp, it resolves itself into a question of temperature. The bigger the arc is, the larger the volume of current and the hotter the arc gets, the more efficient it becomes. Some of the earlier lamps, which carried a heavy current and gave a very short arc, were tremendously brilliant and very efficient. A lamp with a short, flat arc, taking a heavy current, is enormously efficient. It has perhaps 25 per cent more efficiency in producing light than small arcs, because the carbon is carried to a much higher temperature. It is, however, an arc which is not now a favorite, by reason of its unsteadiness and hissing and sputtering. We have passed now almost entirely to the enclosed arcs.

The enclosed arc is simply an arc with an air-tight globe around the carbon, the air-tight globe having a sleeve at the top into which the carbon fits nicely, so that the air has the oxygen burned out of it, the carbon burning in an atmosphere which does not oxidize rapidly and consequently gives a better light. The enclosed arcs generally have around them a second globe. If the second globe is a holophane globe, there will result an admirable distribution of light, which is softened in a way highly satisfactory, without, at the same time, cutting off any considerable amount of the light. The absorption of the globe is probably not over 10 per cent, while the light still looks bright, but is not by any means as dazzling as it would be without a globe, or with a very light ground globe. These enclosed lamps are somewhat subject to different classes of color. The earlier ones gave a very perceptible bluish-white light, a light not altogether satisfactory for general purposes, but, on the whole, a very useful one. As time has gone on, the enclosed arc has become more and more effective, so the light as we have it there is entirely satisfactory in color.

The alternating arc is another example of the way in which the temperature of the heated body affects its efficiency. The first type of alternating arc brought out was the Jablochkoff candle, which was used years ago for illumination in Paris. The light it gives off is curious in color, because between the two carbon elements conveying the current there is a thin strip of kaolin which becomes very hot, and the kaolin gives out, like the lime light, a considerable amount of light of its own. In fact, the principle of the Jablochkoff candle, with its bridge of kaolin between the light and the carbon, is quite similar to the principle of the Nernst lamp which has recently been brought out. In that case there is conduction across a stick of substance which is normally a non-conductor. In this case there is a kaolin strip which passes between the two carbons. The lamp had, from the earliest times, the unpleasant habit of going out on small provocation, and as the lamps were practically used, they had several carbons with a very ingenious way of shifting the current from one to the other, in case one came to grief. The carbon, if you can call it a carbon, consists really of two conducting strips of metal rather than a carbon, properly so called, and between them a stick of kaolin composition. These edges are barely more than copper-plated on the surface, so that while the conductors are really along the edges of the carbon, the white central strip is the thing which gives the majority of the light. They originally started off by using strips of carbon, but the particular sample shown to the audience is a metal conductor running down each edge of the light-giving element, and between the two is a mass of kaolin which becomes a conductor and gives a very brilliant light after it is once started. The principle of using the kaolin, which is itself a non-conductor except at high temperature, as the light-giving element, is, as stated, similar to that in the Nernst lamp, of which we have heard much in the past few months, and probably will hear more. Next we have an example of the alternating enclosed arc, which has the same general appearance of comparative steadiness and long-burning of the carbons that the continuous current enclosed arcs have, but at the same time it is, for obvious reasons, principally lack of sufficiently high temperature, somewhat less efficient. The lights are very serviceable, however, where the direct current is, for one reason or another, not available.

After all, you will say that the efficiency of even our best illuminants is not very high. The efficiency is not anything like what we would have it. It is not a very comforting thing to think of putting in 100 horse-power of energy and getting out 5 horse-power in this form, the form in which you want to use it. It is not consoling to think of utilizing any arc lamp, and getting out, if you have good luck and use a first-rate lamp, 10 per cent of the energy you put in. The efforts of many inventors have been bent in many directions trying to get an arc lamp or incandescent or some kind of a lamp which would return a reasonable amount of the energy put in, but so far none of these experiments have led to anything commercial. The Nernst lamp is extremely interesting as an attempt in this direction. The weak point

of the carbon, as I have already stated, particularly in the form of an incandescent filament, is the fact that it will not stand high temperature. It vaporizes, smokes up the inside of the globe. and generally goes to pieces. The Nernst lamp utilizes a little pencil, hardly bigger around than the lead of a pencil, perhaps 1 in. or 1½ ins. long, of some refractory material, like magnesia; in point of fact, the material used is much like the material used in the mantels of the Welsbach gas burner, but this material possesses the property of being a conductor at high temperature. At ordinary temperatures, it lets through no current, but at high temperature it becomes quite as good a conductor as carbon.

The principle involved is the same as in the Jablochkoff candle. That is, the formation of an electric arc, heating to an enormous degree a pencil, in that case a little thin slip of highly refractory material, which becomes conducting and goes to an enormous temperature, and gives out a great deal of light. By the use of that refractory material, and handling it as deftly as may be, a fair efficiency is obtained, an efficiency, however, which is not greater than we have in the arc light, probably (indicating); that is to say, the highest claimed is about 1½ watts per candle, but the chances are that the filament of more refractory material would outlast the lamp, and in that fact lies its chance for success.

There is a determined effort going on to better the efficiency of the incandescent lamp, but the result is not by any means certain. It is certain, however, that a lamp has been produced which does give an efficiency as high, or higher than can be obtained by any incandescent lamp, and approximating that which can be obtained by the smaller light of the electric arc, and that is one very encouraging direction for experiment. I imagine that in six months or a year the Nernst lamp will become, perhaps not a common sight, but a lamp which will be found more readily than one could be found for the purposes of this lecture.

An interesting line of operation is that which depends on the dropping of incandescent solids and passing to incandescent gas. The phenomenon on which experiments of this kind are based is that of the passage of electricity through rarefied gas, such as seen in the ordinary Geissler tubes. There is every reason to believe it is possible to extract from incandescent gas perhaps as high as 25 or 30 per cent put in it, in the form of light. Nevertheless, the difficulties in the way are many. We have available very good incandescent lamps, very good arc lamps, and we have an enthusiastic hope of getting something along the line of the Nernst filament which may be useful. We have an earnest wish that we may perhaps discover in the use of incandescent gas a higher efficiency than we can get from solid incandescence, and we have an illusory sort of an idea that, if fortune favors, we may discover the secret of the glow worm, but of that the glow worm himself will have to speak. Science does not know his mind in that regard. So we can say, in summing up the progress, at present we have a very useful means of illumination, but we have not, by any means, yet reached the point where we can look pleasantly on our artificial illumination and say we have anywhere nearly what we want.

Detective Telephony in France.

A most extraordinary scandal has come to light at Lyons. Charles Meyer, a permanent police official of many years' standing, is found to have been the centre of a reactionary conspiracy in which 2000 men of the detective and police forces, who were devoted to him, have been kept busy shadowing successive prefects and local functionaries. The revelations were due to Meyer's illness. The Prefect, M. Alapetite, required documents out of Meyer's room. He sent to him for the keys, but Meyer kept putting him off. At last he said he had lost the keys. The Prefect then threatened to break open the door. Meyer was desperately ill, but he dragged himself to the office and removed an enormous quantity of documents and opened all the drawers and cupboards. The Prefect searched the room and discovered evidence of Meyer's complicity with the reactionary movement. But his astonishment was still greater when he found under the false bottom of a big box a powerful battery, such as is used for microphones, with wires leading into the wall. He afterward discovered wires that communicated with the Prefect's study, dining room and bedroom with receivers concealed under the Prefect's desk. Meyer was thus able to hear every word the Prefect uttered, wherever he might be. Meyer has been dismissed, and further investigation is being made.

Electric Fountains for the Pan-American Exposition.

BY ORRIN E. DUNLAP.

HENRY RUSTIN, chief of the mechanical and electrical bureau of the Pan-American Exposition, is in receipt of the plans for an electric fountain which is to be located on an island to be built in the North Bay, a section of the Buffalo Park lake system. It is a beautiful body of water, and has been included within the limits of the Exposition grounds. It has a width of about 800 ft., while its length is about 900 ft. The banks surrounding it are thickly wooded and about 28 ft. high. They slope gradually to the water, and in their height and forest growth they will serve as a most appropriate setting for such a display as that proposed in connection with the electric fountain. While there will be water and light effects in and about the electric tower and the adjacent basins, there will be no other spectacle that will be called an electric fountain, and it will remain for the North Bay to have all the glory connected with this magnificent display.

At present there are no islands in the North Bay, but to provide the necessary accommodations for the fountain an island is to be built 160 ft. long, 80 ft. wide and 10 ft. above the water level. It will be constructed of rock, and its form will be quite irregular. The entire interior of the island will be a submerged chamber in which the necessary installation and operators will be located. The rock will be whitened on the rough sides in order that better light effect may be obtained, but in no feature will the island construction be such as to in the slightest mar the beauty of the scene by day. In the daytime the island will appear as a rock-bound shore, quite in keeping with the bay and woodland surroundings.

The intention is not to have it in constant operation, but each evening for about 25 minutes. It will commence at a specified hour, in order that all who care to see it may be on the wooded shore. The evening displays will be varied night after night, in accordance with a previously arranged programme. There will be nine different piping systems, each of which will be controlled by operating levers, which will permit of from 100 to 150 combinations of light and water effects. There will be a total of about 102 fountain orifices and 22 holophote orifices. The individual jets making up the several combinations will be grand geyser, ring curtains, ring jets, wheat sheaves, geysers, lily jets, pulverizers, fan jets and mist banks.

The grand geyser jet will be located approximately at the center of the fountain. It will throw a 1½-in. solid stream perpendicularly 250 ft. in the air. It will be unbroken. At certain periods of the programme the grand geyser jet will be the center of a mammoth pyramid of water in motion, while in other water figures, which will appear on the programme, it forms a jagged outline not unlike a pine tree in shape. The ring curtains when in operation with other jets will form a cylindrical figure of water cut off at the top evenly by the limit of the force given to the jets by the operating valves. The ring jets of the electric fountain will be not unlike the ring curtains, except that the individual jets are farther apart and each orifice maintains its pillar of water to the highest point of projection without breaking, thus giving, when illuminated, an appearance of threads of light thrown vertically in the air.

The wheat sheaves will be of the form their name indicates. In height they will be of a most impressive beauty, and the proper outline will be carefully adhered to. The geysers will be similar to the giant geyser, but not so large, nor will the jet rise to the height of the grand geyser. In the lily jets all the purity of the calla lily, together with its beauty, will be portrayed. These water flowers will be 14 ft. high, approximately. The pulverizers will throw the water in pulsating vertical streams to a height of 25 ft. These streams will be intermittent in their action and automatically controlled. The fan jets will be all that their name suggests. The figures will be 15 ft. high, and 20 ft. in extent at the top. By means of the mist banks the whole surface of the electric fountain will be covered with a very dense mist formation.

All of the different effects of both light and water will be controlled by the operators in the submerged chamber. When certain levers are pulled by the water operator to give specified water effects on the fountain surface, the programme that the operator of the lights will play will correspond in every particular, so that the switches he will throw will cause the proper light and color effect to fall upon the water effect. Each will have his programme before him, and each will play his part on time. The lighting of the fountain will be accomplished by 22 projectors so arranged that they can be diaphragmed

and focused at will. The searchlight to be used will be the regular fountain projector lamps of 22-ampere capacity, and they will be supplied by Mr. Charles J. Bogue, of New York City. There will be 22 color screens in the form of circular disks, each having the primary colors, and these colors will be projected on the different water effects when in operation. The light will reach the water display through the holophote openings, which will be equipped with clear glass plates, varying in size from 30 in. up. The glass of these openings will be so arranged as to make an absolutely water-tight joint, so that it will be impossible for water to find its way through them to the operating room.

The operating chamber proper of the fountain will be located below the central portion of the fountain deck. In this chamber will be located two pumps which will be supplied by the P. H. & F. M. Roots Company, of Connersville, Ind. One of these pumps will have a capacity of 3000 gallons per minute, with a pressure of about 50 lbs. The other will have a capacity of 600 gallons per minute, with a pressure of 150 lbs. The pumps will be located on the north side of the chamber, and will take their supply direct from the bay. The larger pump will supply all the fountain orifices with the exception of the grand geyser, the orifices of which will receive its water from the smaller pump and under the greatest pressure, which is, of course, necessary to force the solid stream 250 ft. in the air. In this chamber there will also be a 500-volt, direct-current motor of Westinghouse make. This motor will operate the countershaft which will be belted to the pumps. The current for operating the motor-driven pumps will be obtained from the 500-volt circuit provided for use of motors on the Exposition grounds, and will come from the service plant. The current for operating the lamps will be derived from a motor-generating set, to be furnished by an exhibitor, as yet unannounced. This motor-generating set will be located in an artistically designed booth on the west bank of the North Bay.

The direction of the Electric Fountain Island will be southwest by northeast, and it will extend full in front of the New York State Building, but it will be possible to get a good view of it from all the surrounding points. Mr. Luther Stieringer, who has had more electric fountain experience than any other man in the world, is the consulting electrical engineer of the Exposition.

Illuminating the Pan-American.

Considerable interest attaches just now to the electrical illumination of the Pan-American Exposition, and we have been given to understand that the plan adopted under the advice of Mr. Luther Stieninger, the consulting electrical engineer, will involve the use of 200,000 incandescents of 8 cp. He believes this unit quite large enough for effective exterior work, and says that, in fact, admirable results would probably be obtained with an even smaller unit, in spite of the great extent of the grounds and buildings.

With regard to this subject, a rather amusing art note appears in the New York *Times* as follows: "The electric illumination for the Pan-American is exercising the wits of the authorities of the exposition. The ordinary method of giving brilliant effects at night to buildings is to outline the chief architectural members with rows of electric bulbs. This has been done hitherto with little understanding, because the men who have the work to do are engineers, not artists. Will the Pan-American turn over a new leaf in this respect? That is the question that agitates the very respectable number of the Buffalonians who are abreast of the times in things artistic. There was a charming suggestion last year to have the banks of the canals set with torch holders, the torches to give out a combination of steam and natural gas, which can be had from the soil at the expense of laying mains of no great length, thus affording a fitful moving flame, lighting up clouds of steam. What has become of this suggestion? During the hot months the Pan-American will be crowded at night, and some system of illuminating the grounds and buildings other than the regular lines of electric bulbs will be appreciated by the public. In such matters there should be a conference of the color director, the sculpture director, and the architect with the manager of the external lighting of the fair, and experiments made in the way of concentrating the lighting elements. Hitherto our expositions have suffered from scattering of lights. Distributed over large surfaces, they look meager and ineffective, when by an artistic scheme of concentration here and there they might reach very beautiful results. It would be a pity if the Pan-American should neglect this important feature under the stress of the many other matters that keep the managers of the fair on the jump."

It might be added that the architects have little idea how they distress the engineers with their plans for using light, a subject which, it would seem, very few of them have ever studied. At the World's Fair in 1893, one or two of the architects wanted for their own individual buildings all the light available for the great show itself; failing moreover to realize that light means horse power, with a big bill for apparatus, coal, water and attendance. In other words, lighting is not exactly a matter for architects nor for engineers, but a special art and a subject of special investigation.

The Soc ety of Model Engineers.

The Society of Model Engineers held a meeting on the evening of Feb. 2, in New York City. Two preliminary meetings had been held, but this was the first one in which the actual organization of the Society was begun. Mr. Arthur J. Weed was elected president; Mr. M. Toepel, vice-president, and C. Kehrer, secretary and treasurer. A committee was appointed to draft a set of by-laws. About 25 gentlemen were present, and nearly all were enrolled as charter members of the Society.

An exhibit of models was held in conjunction with the meeting. The electrical portion was shown principally by Parsell & Weed, who had an operative display of their well-known Franklin dynamos and motors running both from the Edison circuit and from a 5-cell Perret storage battery. This battery, interesting on account of its light weight, about 83 lbs. per kw-hour, was loaned through the courtesy of Mr. William H. Meadowcroft, the manager of the Perret Storage Battery Company. This is the first public exhibit of the new cell.

Messrs. Toepel and Widmayer showed one of their 1-hp bicycle motors complete. Mr. B. R. Wicks, of Bridgeport, Conn., sent a photograph and blue prints of his ¼-hp high-speed engine. Mr. C. Kehrer exhibited two electric motors, one of which was series wound and could be adjusted to various speeds by a movable third brush on the commutator, which was connected to act as a variable shunt to the field. He showed also a sectional model of a valve gear and a D'Arsonval galvanometer in a nearly finished state.

The object of the Society of Model Engineers is to bring together all who are interested in the construction and making of electrical and mechanical models and apparatus, and to aid and instruct those members who meet with difficulties in their work. Competitive exhibits are also to be held at which prizes will be awarded the finest models. Any one who is desirous of associating himself with the Society is requested to communicate with the secretary, Mr. C. Kehrer, No. 1200 Madison Avenue, New York City.

Post Office Tubes.

The joint committee representing 19 commercial organizations of this city, which are united in an effort to secure a new post office and generally improved postal facilities in this city, at a meeting held in the room of the Board of Trade and Transportation last week, approved heartily of the favorable report of Senator Platt's bill made by the Senate Committee on Public Buildings and Grounds, and adopted resolutions urging the Senators and members of Congress from this State to use their influence to secure its enactment. The joint committee of commercial bodies also adopted resolutions relating to the pneumatic tube service in this city, urging the extension of the service to the several boroughs of this city and post office stations to which it can be made with advantage. The resolution says that the daily average of first-class mail matter transmitted by the tubes amounts to over 1,000,000 pieces, and in the tube between Manhattan and Brooklyn more than 160,000 pieces of first-class matter are transmitted daily.

Ducretet Coherer.

One of the first instrument makers in the world to engage in the commercial manufacture of wireless telegraph apparatus was Ducretet, of Paris, which house has introduced a number of new features in the apparatus. One of these is the subject of a patent granted Jan. 15 to Eugene Ducretet, of Paris, in which an improvement in the Branly tube is described. Hard-tempered steel powder is used, confined in the usual tube between the end rods, which latter are adjustable by means of threads therein engaging with threaded caps on the ends of the tube. Renewal of the air in the tube is prevented by suitable joints at the ends of the tubes. Means are provided for locking the rods in position.

CURRENT NEWS AND NOTES.

AMERICAN PHYSICAL SOCIETY.—The annual meeting of the American Physical Society will be held in New York, Feb. 23.

PASTRY AND ROENTGEN RAYS.—English papers note the case of a Hampstead matron who, having lost a valuable ring while kneading paste for some cakes, and not having discovered the loss until the dainties were baked, took them to a scientific man for the purpose of having them examined by means of the X-rays.

THE COLUMBIAN UNIVERSITY, Washington, announces that it will give a course in electro-chemistry, in the form of a special course of lectures by Mr. N. Monroe Hopkins, during the second half year, beginning Feb. 1, 1901. The lectures will treat of the use of electrical energy in analytical and synthetical operations in the laboratory and in the arts, and will be illustrated by numerous experiments. The various means by which electric energy is generated and the means by which it is conveyed and employed will be described and the student will be taught how this form of energy can be practically utilized in many kinds of chemical operations. Abstruse mathematics will be avoided, and an effort will be made to present the theory in a simple manner.

THE IMPERIAL CABLE INQUIRY.—Official advices have been received at Ottawa to the effect that a departmental committee has been appointed by the Imperial Government, consisting of Lord Balfour, of Burleigh, chairman; Lord Londonderry, representing the Treasury; Lord Hardwick, Under-Secretary for India; Lord Onslow, Under-Secretary for the Colonies, and one representative each from the intelligence branch of the army and of the navy. The terms of the reference are as follows: To inquire into the present system of telegraphic communication between the different parts of the British Empire, and to investigate the relations between private cable companies and the Imperial and Colonial Governments (including the Government of India), the amount of control at present exercised by these Governments, and the policy which should be pursued by them in future, especially when new concessions are sought; to examine existing rates; to report how far they are fair and reasonable, and, if not, how much reduction should be effected.

IOWA ELECTRICAL ASSOCIATION.—The annual meeting of the Iowa Electrical Association will be held in the club rooms of the Savery Hotel in the city of Des Moines, Feb. 20 and 21, 1901, beginning at 10 o'clock a. m. The executive committee has prepared a good programme, and a most interesting meeting is anticipated. Papers have been prepared and will be read upon the following subjects: "An Analysis of the Cost of Supplying Electric Current and the Various Systems of Rates," "The Regulation and Control of Wiring," "Central Station Heating—Mechanically and Financially," "The Renewal of Incandescent Lamps," "The Gasoline Lamp," "Experiences with Mechanical Draft," "Pounds of Coal Required to Produce One Kilowatt Hour," "How Can Delinquent Bills Be Prevented Without a Net Loss of Business," "The Massachusetts Laws." The officers are: President, W. J. Greene, Cedar Rapids; vice-president, H. H. Caughlan, Ottumwa; treasurer, George S. Carson, Iowa City; secretary, W. B. Keffer, Des Moines. Executive Committee—W. J. Greene, H. H. Caughlan, W. B. Keffer, W. S. Porter. A. Edgecomb.

NEW YORK ELECTRICAL SOCIETY.—The 212th meeting of the Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, on Thursday, Feb. 14, at 8 p. m. Mr. Kempster B. Miller, whose writings on the subject of telephony have made him the foremost exponent of the art in this country in technical literature, will address the society on "Modern Telephone Engineering." This will be the first lecture on telephony which has been delivered in New York City in many years, and will constitute a most important review of the engineering situation. Mr. Miller will start with the power plant of an exchange, describing its functions, and will then go on to treat of the whole system in detail and discuss rather the engineering problems than merely the design of apparatus or circuits. He will also devote attention to the question of exchange location in any given city, so as to obtain the greatest economy and efficiency, and will present actual statistics and curves illustrative of telephone exchange activity. The lecture will thus be of the most lively interest, not only for those occupied in telephony, but for the general public. It will be illustrated by lantern slides.

MEANS FOR PREVENTING HUNTING OF SYNCHRONOUS MOTORS.—When a synchronous motor is driven from a generator direct-connected to a steam engine, the moving parts of which do not possess sufficient inertia to preserve a uniform angular velocity throughout each revolution, the generator speed fluctuates periodically with that of the driving engine, thereby producing an alternating current of pulsating frequency, which will cause a synchronous motor driven from the source of supply to pulsate in speed correspondingly. To remedy this defect is the object of a patent issued Jan. 29 to H. W. Buck, which describes means for varying the field excitation of synchronus motors within certain limits, and in time with the engine stroke, an interference being thereby caused and the pulsation broken up. The field resistance is actuated by a mechanical connection with the shaft of the motor. A worm on the latter drives a wheel which carries a crank pin. A connecting rod from this pin gives motion to a contact device, which moves back and forth over rheostat contacts, thus periodically varying the resistance in the field circuit of the motor.

ROTARY CONVERTER PROTECTIVE DEVICE.—Under certain conditions existing in practice, rotary converters or similar machines are liable to increase abnormally in speed or to "run away." The most serious danger in this respect exists when a rotary converter is fed with direct current to be converted into alternating current, which in the case of an inductive load may lead to a weakening of the field of the converter, thus causing it to speed up in the same manner as in a direct-current motor with weakened field. Again, if the direct-current end of a rotary converter be connected with a direct-current end of rotary converters or other sources of direct current, and the alternating-supply mains are interrupted, the immediate result is the reversal of current in the direct-current side of the machine, and if provided with a series field winding, as usual, the field strength is reduced by the reversal current and the machine speeds up. A patent issued Jan. 29 to H. W. Buck describes automatic means to interrupt the supply of current to a rotary converter or other supply when the speed rises a predetermined amount above the normal, the device described being responsive to the frequency of the current in the alternating mains. In one form of the device a solenoid provided with a core is connected across the alternating current mains, the core being adapted to establish the circuit of a circuit breaker. Under normal conditions the core is drawn within the solenoid; in case of an increase of speed in the rotary converter the increase of frequency in the line increases the inductive e. m. f. of the solenoid, thereby decreasing the flow of current through it. The solenoid core then, through gravity or by means of a spring, is caused to close the circuit of the circuit breaker, which latter then throws the converter out of circuit.

TELEPHONE PATENTS.—Commencing with the statement, "It is, of course, well known that the distance over which speech can be transmitted by the telephone apparatus now in use is limited by the amount of current which can be sent over the line wire, and that the amount of this current is fixed by that which can flow through the transmitter without arcing or producing a hissing sound," G. L. Hogan in a patent issued Jan. 29, describes a form of transmitter devised to increase the amount of current on the line wire. In the arrangement the inductance coil of the usual transmitter, instead of connecting to the line, makes connection with the coil of an electromagnet, the core of which serves to operate a diaphragm on which there are a plurality of microphone contacts, in connection with each of which there is a battery and induction coil. When the diaphragm of the transmitter is caused to vibrate by the sound waves, the telephonic current operates the second or repeater diaphragm, which in turn operates the multiple contacts, which finally cause the impulses to be sent over the line circuit. A multiple microphone is the subject of a patent issued the same day to A. G. Holcombe. In the microphone case opposite the diaphragm is a spring strip, and secured to this strip at one end and to the diaphragm at the other is a rectangular frame. This frame consists of two metallic strips secured to insulating end pieces, the latter in turn being secured to the diaphragm and spring strip, respectively. One pole of the electrical circuit of the microphone is connected to one of these strips, and the other pole to the second strip. Between the two strips are mounted the microphonic elements, which outwardly have the appearance of cylinders with trunnions, which enter into holes in the two strips. Each element consists of two carbon cups, with a loose carbon kernel; granulated carbon being arranged around the loose kernel and between it and the cup-shaped end members.

SLABY ON TESLA.—A special cable dispatch of Jan. 30 from Berlin says: "Prof. Slaby, of the Technische Hochschule, said in an interview to-day that he expected to revolutionize telegraphy if he was successful in applying his etheric system, which he calls spark telegraphy, to the present system of transmission by wire. He added that thousands of telegrams could then be transmitted simultaneously by the same wire. He characterized Nikola Tesla's expectations of an enormous reduction in the cost of electric currents as those of a fanatic, and said that the immediate future does not promise an improvement in the cost of conduction."

ELECTRICAL PROCESS OF MAKING PAINT.—Among the patents of Jan. 22 are two granted to C. G. Collins, on a process for making pigments, in which the electric current is employed. The object of the invention is to insure the more intimate and positive union between the soluable coloring matter, such as coal tar or aniline dye and the body with which they are united to form a paint. As an illustration of the process, to an aqueous solution of barium diathonite an aniline salt is added capable of electrolytic dissociation. The mixture is then subjected to the action of an electric current, when insoluble bi-sulphate in a freshly generated state and in a condition of extreme sub-division will be generated. At the same instant the aniline salt dye will be electrolytically dissociated and the circulating ions will recombine with the precipitated barium and fall to the bottom of the vessel as an insoluble fine powder having the color of the coal tar or aniline dye which was before in solution. A second patent relates to the production of silica paint from hydrated silica or silicic acid in the presence of a solution containing a dye salt.

ELECTROLYTIC PROCESS FOR WATER PURIFICATION, REFINING PERFUMES AND STERILIZATION.—Three patents granted Jan. 22 to J. H. Lavollay and G. E. Bourgoin, of Paris, France, relate respectively to electrolytic processes of purifying water, of refining perfume and the sterilization of liquids and beverages. The latter consists in subjecting the fermented liquids to the combined action of an electric current and a suspended alkaline earth-metal manganate or other insoluble manganate. In carrying out the process, a small quantity of, say, calcium manganate is added to the worts and a current of from one-tenth to one-half ampere per square foot is passed through the mass for 5 to 10 minutes. The advantages stated to be derived from this process are complete and rapid decantation, the bettering of the flavor of the product and the destruction of foreign or parasite germs or ferments, thus insuring the preservation of the liquid. The same process is applied to the refinement of perfumes and purification of water—that is, the addition of a small quantity of an alkaline earth-metal manganate with subsequent electrolysis.

ELECTRIC LIGHTS IN CANADA.—Mr. George Johnson, of Ottawa, the Dominion statistician, says that the development in the use of electric lamps in Canada is marvelous. In 1891 the census returns gave 80 establishments selling electric light in the Dominion. 1897 there were 187, which number increased to 297 in 1900. The electric lamps supplied by the establishments selling light numbered 443,897 in 1897, and 807,772 in 1900. The largest establishment in Canada in 1900 was the Royal Electric Light Company, of Montreal, supplying 78,762 incandescent lamps and 1805 arc lights. The next largest is the Toronto Electric Light Company, supplying 75,000 incandescent lamps, and 1650 arc, while the Ottawa Electric Company stands well to the front with 77,255 incandescent lamps and 621 arcs. The Province of Ontario has made rapid strides in the employment of electricity for lighting purposes, using 418,573 lamps in 1900, against 201,955 in 1897. The Province of Quebec increased the number from 185,892 lamps in 1897 to 235,322 lamps in 1900. The other provinces have all developed the use of electricity for lighting purposes in a very satisfactory manner. British Columbia had a couple of establishments selling electric light in 1897, and these operating only a very small number of lamps. In 1900, however, this province had 13 electric companies, with an equipment of 52,653 lamps. The use of the arc light in Canada has increased from 9,516 lamps in 1897 to 11,917 in 1900. In gas lighting, the census of 1891 gave 49 gas works in Canada. In 1900 there were 43, thus showing a decrease of 6 gas works.

DR. SHELDON ON ELECTRO-CHEMISTRY.—Last week in the chemical lecture hall of the new Polytechnic Building, Brooklyn, Prof. Samuel Sheldon, Ph.D., lectured before the members of the Brooklyn Institute (Department of Electricity), on "Electro-Metallurgy and the Storage-Battery." He thought that for the young man who is intending to devote himself to electrical engineering as a profession and as a means of livelihood, the field of electro-chemistry is very attractive. Another advantage is that it is not crowded as yet, for many chemists are too deficient in mathematical and electrical training to do effective work in it and electrical engineers are equally uninformed in chemistry. "The twentieth century," said the lecturer, "promises much to the person well trained in each of these branches." One of the most interesting portions of the lecture was where Prof. Sheldon explained the workings of the electrical furnace which makes it possible to maintain evenly any temperature up to 6000 degs. F. "By its use," said he, "Moissan was enabled to make diamonds, microscopic as to size, but equal in quality to the cosmic article." As to the battery, he said: "The storage battery of the present is the result of the expenditure of much time and money coupled with brains, but is still," the lecturer said, "an unsatisfactory thing, though playing an important part in the operation of electrical plants."

ELECTROLYTIC PRODUCTION OF ALKALI.—In the manufacture of caustic alkalies, the usual method is through the medium of an alkaline metal amalgam obtained by the electrolytic decomposition of solutions of alkaline and chloride with mercury cathode. In most of these arrangements, the alkaline metal amalgam is caused to pass through the compartments in which decomposition is produced, to a second or more compartments supplied with water. In this latter, the amalgam is partially denuded of its alkali metal and then returned to the first compartment to receive a fresh charge. A patent was granted Jan. 22 to J. W. Kynaston, of Liverpool, England, on a form of denuding apparatus which, it is claimed, will permit of a more perfect denudation of large quantities of amalgam in a comparatively limited space, allow the use of amalgam much richer in alkali metal and enable hydrogen and electricity to be produced at the same time. The apparatus consists of an iron casing having on its interior walls a large number of tiers of narrow horizontal shelves, also of iron, and hollowed out on the upper surface to a depth of about one-half an inch. In the central space left by the shelves in the case is suspended an iron tube or box extending almost to the bottom of the case, this serving as a cathode element in relation to the amalgam upon the shelves, the arrangement thus constituting a voltaic cell. In starting to manufacture, the case is first about half filled wtih water and a liquid amalgam is then passed in on the upper shelf, which falls through an opening in the farther end thereof to the next shelf and so on until all the shelves are charged. The stream being continued, the amalgam falls and covers the bottom of the vessel, when the mercury is almost completely denuded of alkaline metal and allowed to flow out of the vessel. When the solution of caustic alkali has attained a sufficiently high degree of concentration, it is withdrawn by means of a tap. The hydrogen gas liberated passes away through an aperture provided for the purpose, and may be utilized as fuel for driving gas engines or other purposes.

LETTERS TO THE EDITORS.

Resonance and Leaka e Effects.

To the Editors of Electrical World and Engineer:

Sirs:—Certain phenomena arising on high tension transmission lines are frequently ascribed to resonance when a careful consideration of the entire circumstances might show that they are in reality leakage effects. The phenomena to which I refer are commonly called in the West "static," and consist in an apparent discharge from the lines to insulated bolts and from metal work. An explanation offered as to this effect is that resonance accumulates a charge on the line which is discharged through the air to some neighboring insulated piece of metal work, which discharges itself gradually through the air and again receives charge from the line. These sparks are rarely occasional sparks, but generally consist in an almost continuous sparking.

In no case have I ever known the bolt or other piece of metal to have an area sufficient to account for the apparent charge it was taking, and in no case have I ever been able to examine such an effect where it was not found that the insulation of the apparently insulated piece of metal was defective. In one case on a 10,000-volt line, switches were used with ash handles about 4 ft. in length, these handles being

held in place by a clamp set in the centre of a 24-in. block of marble. The handles were painted black with carbon paint and a continual sparking was observed between the handles and the clamp. In one case the handles caught fire and burned up, showing that a very considerable amount of current e. m. f. was passing. The effect was finally gotten rid of entirely by placing a sheet of micanite between the handle and the so-called insulated clamp.

In another case, when experimenting with 34,000 volts, I noticed a spark passing through an insulated bolt and while the men about were calling my attention to the "static," the line short circuited across the face of the marble switchboard and in the path of this previous spark, the e. m. f. jumping across 18 ins. of marble, showing that in this case again the so-called "static" was due to leakage. I might continue reciting such cases in great number, but as they all result in the same conclusion that the discharge was the discharge of the line voltage to ground through defective insulation, I do not think it necessary to increase the number of instances.

It is my opinion, therefore, that many of the effects attributed to resonance are due simply to defective insulation, and, taking this into account, are no more remarkable than could be expected from the voltage of the line. Resonance undoubtedly occurs in some cases, and in a recent paper before the American Institute of Electrical Engineers, I cited a case of a motor action which is difficult to explain in any other manner, particularly as the difficulty was experimentally corrected by a correction for resonance.

PITTSFIELD, MASS. F. A. C. PERRINE.

The De Laval Steam Turbine.

To the Editors of Electrical World and Engineer:

Sirs:—In a paper by Mr. Francis Hodgkinson, read before the Engineers' Society of Western Pennsylvania, and published in part in your issue of Dec. 29, 1900, Mr. Hodgkinson, speaking of the bearings and rigid shaft of the Parsons steam turbine as compared with the slender flexible shaft of the De Laval steam turbine, does so in a way that may possibly convey the idea to the minds of your readers that the De Laval flexible shaft is liable to crystallization and eventual rupture. Judging from the thorough knowledge Mr. Hodgkinson seems to have of the De Laval steam turbine, such an implication can not have been intentional. The object of the De Laval fiexible shaft is to allow the turbine wheel to revolve around its true centre of gravity, thereby decreasing the pressure and friction in the bearings, and also eliminating all vibrations. This in fact it does, and there is not a single record of the shafts having ever been broken on account of crystallization.

At the Paris Exhibition a De Laval turbine was exhibited which has been in daily operation for seven years, during that time completing about 20,000,000 revolutions, and without any of its original parts having been replaced. The writer knows of one instance where a flexible shaft and turbine wheel, having run about the same length of time as the above machine, were cut into testing pieces and tested, and the material was found to be practically unchanged.

PHILADELPHIA, PA. E. MEDEN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Determining the Slip of Induction Motors and the Co-Efficient of Non-Uniformity in the Revolution of an Alternator.—HOSPITALIER. An article describing a stroboscopic method for these purposes. It is based upon the observation made by Samojloff, that when a disk, consisting of black and white sectors and illuminated by an alternating current incandescent lamp, is revolved at a speed per second equal to the double frequency of the current, divided by the number of white sectors, then the disk appears to stand still (Digest, Nov. 17). To determine the slip of an induction motor, a disk is mounted on the motor axle, with white and black sectors of a number equal to twice that of the poles of the motor, and it is lighted by an incandescent lamp supplied with the same alternating current as the motor. On account of the motor slip, the disk appears to revolve in the opposite direction with an angular speed which is equal to the difference between the synchronous speed and the real speed of the motor. This apparent speed is measured, and the slip may then be easily calculated. For measuring the co-efficient of non-uniformity of revolution of an alternator, a 110-volt 5-cp incandescent lamp can be used, but an arc lamp, supplied with current from the alternator to be tested, is more practical. This alternator supplies current to a synchronous motor, which is provided with a flywheel large enough to make the speed of revolution uniform, so that it does not follow the variations of angular speed of the alternator during a revolution, but rotates with a uniform mean speed. The disk with white and black sectors is mounted on the motor-axle. If the rotation of the alternator were entirely uniform, the disk would appear to stand still. If, however, the speed of the alternator during a revolution is not uniform, the disk appears to oscillate to and fro and the amplitude of the oscillations represents the degree of non-uniformity of speed of the alternator.—*L'Ind. Elec.*, Jan. 10.

LIGHTS AND LIGHTING.

A New Electric Welsbach Light.—MICHAELIS.—A brief note stating that Auer von Welsbach, the inventor of the Welsbach light, had made a new and very important invention, but the description of the principle involved is not very clear. It is claimed that in the new Welsbach electric incandescent lamp only one watt is consumed per cp, against 1.6 to 2.0 with the Nernst lamp and 3.1 to 3.5 with the ordinary incandescent lamp. Welsbach is said to have invented a process of making osmium filaments. The lamp is said to yield a pure white light. Prof. Slaby is said to have examined it and to have made a very favorable report.—*Elektrotech. Rund.*, Jan. 15.

Train Lighting.—An article on the different systems of train lighting. Reference is made to a recent railway accident in Germany, in which the train was lighted by gas and an explosion occurred. The trial of the Stone system of electric train lighting, which has been made between Berlin and Cologne, is said to have been unsuccessful, not because the principle is wrong, but because it was not well carried out. Care must be taken that the storage battery is not overcharged by the dynamo. Furthermore, the commutator must be spared, for as lighting is required only for five hours per day, the commutator is being worn off uselessly 79 per cent of the day; the variations of the lights must be prevented, when the dynamo is being connected or disconnected. These requirements are claimed to be fulfilled in a new system devised by Zehden, which is briefly described. The following three systems of train lighting are compared: Gas lighting, electric light from a storage battery, and electric light from a storage battery in combination with a dynamo. The result of the comparison is that the last is the cheapest and the best. The cost of a 12-cp lamp hour is given as 0.58 cent for gas, 0.63 cent for electric light from a battery and 0.49 cent for electric light from a battery in combination with a dynamo.—*Zeit. f. Beleucht.*, Dec. 20, 30.

POWER

Power Distribution in Workshops.—ESSON.—A paper read before the (Brit.) Civ. and Mech. Eng. Soc'y. He first considers the two older forms of power distribution in workshops. First, the power being supplied by a number of engines driving individual machines or departments of the plant; second, one engine furnishing the whole power which is distributed to the various machines by shafting and belts or ropes. The first of these systems is very wasteful, as the fuel consumption is extravagant beyond all reason. Regarding the second system, he gives the following data: From the results of tests in eight factories in the United States the power utilized to drive the machine tools averaged 26 per cent of the indicated horse-power, while in one extreme case, that of the Baldwin Locomotive Works, the return was only 20 per cent. From tests in over 300 factories in France, an average return of less than 60 per cent was obtained. The percentage of useful return always decreases rapidly as the machines are thrown out of work, or as the load on them is diminished. He then begins to discuss electric power distribution. He gives in a diagram the curves of ihp and hp useful returned, with varying load. At full load we get from the motors 66 per cent of the ihp, at three-quarter load 64.3 per cent, at half

load 59 per cent, and at one-quarter load 47 per cent, if the motors are stopped as the machines they drive are thrown out of action. He then gives a diagram in which the system of shafting and of electric power distribution are compared. It shows that at full load about 10 per cent in the ihp are saved by electrically distributing the power, and at three-quarter load, half and one-quarter load, 16, 24 and 38 per cent, respectively. He also discusses more briefly the other advantages of electric power. There is a saving, as electric motors require considerably less attendance than do shafting and belting or small engines. Furthermore, electric driving places no restriction as to the position of the machines, and they can be placed with regard only to economy in production. In displacing shafting and belting, the increased output constitutes the chief advantage of electric driving. Wherever electric motors have displaced small steam engines, large savings have resulted, and cases have been known where the whole cost of the electric plant has been returned in one year as saving in fuel and wages. The discussion which followed is also reprinted. Hanssen believed that in future electricity would have a very formidable rival in compressed air.—Lond. *Elec. Eng.*, Jan. 11. The first part of the paper also in Lond. *Elec. Rev.*, Jan. 11.

Richmond Water-Power Plant.—A long illustrated description of the plant of the Virginia Electric Railway & Development Company, of Richmond, Va., which is to supply current for lighting and railways. There is to be an elaborate hydraulic plant in the James River Rapids, with a steam auxiliary plant. The final equipment of the power house will consist of 11 generating units, of which 4 are at present installed. These units consist of 2 turbines connected on the same shaft to a 750-kw, 12-pole, 550-volt direct-connected dynamo, a 76,000-lb. flywheel and a "steeple" tandem compound steam engine, rated at 700 hp. The dynamos give 550 volts direct current at no load, and are overcompounded to give 580 volts at full load. For the distribution of light and power a three-wire system, with 470 volts between the outers, was adopted, and to make use of the 550-volt generators on the lighting load, two 100-kw balancer sets were installed. They consist of two 50-kw, 250-volt machines, rigidly coupled together, giving a neutral wire balancing current of 400 amperes at normal load and 580 amperes at 40 per cent overload. For equalizing the voltage of the different feeders at time of maximum load, a three-unit booster set is used.—*Elec. Rev.*, Jan. 26.

TRACTION.

Electric Tramway Plant.—BOOTH.—An article on "Economies in the installation of electric tramway plant." He defines the load factor as the ratio of the mean output of a station to the maximum load. An empirical formula, which he claims to be a fair approximation to the conditions of ordinary English tramway work, is that the load factor in per cent is 11 times the third root of C, where C is the average number of cars run per hour the line is at work, and is found by "dividing the number of car-hours in a given time by the number of hours run by the station." Thus if in a system an average of 27 cars are always at work, the load factor is practically 33 per cent. In other words, while a plant must be capable of doing a maximum duty of 100 its average duty will be only 33. He speaks strongly in favor of condensing, and prefers simple to compound engines. "A point in which American electrical manufacturers have scored great success is in the close designing of their traction generators." Practically it is desirable in small systems to select the smallest and simplest engine, and to provide for its most economical working by running it on a condenser with superheated steam from boilers fed through a flue-feed heater.—Lond. *Elec. Rev.*, Jan. 18.

Electrolysis from Railway Return Currents.—HERRICK.—An article on this question. Where current flows into a water pipe it forms a film of hydrate on the pipe, which protects it effectually from the natural corrosion due to any condition of soil. Where, however, current flows out from a water pipe oxides or chlorides or nitrates are formed and the pipe may be destroyed. Trouble has been principally complained of where service pipes pass underneath the track in the locality of the power station. Service pipes with insulated coverings may be used there or the pipes may be imbedded in cement or inserted in terra cotta pipe filled with cement. All of these methods introduce a resistance in the electrical circuit at the point to be protected, and, if properly applied, can reduce the flow of current to a negligible quantity. Cast iron used in the mains of a water-pipe system is very much less susceptible to electrolytic action than either wrought iron or lead, and in some soils it is immune from any damage, even where large current densities have been known to flow from the surfaces for a period of years.—*St. R'y Rev.*, Jan.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Capacity in Alternating Current Working.—MORDEY.—The first part of a paper read before the (Brit.) Inst. Elec. Eng. To give an idea of what a microfarad is, he says that it takes 0.6283 amperes at 2000 volts and 50 periods. He draws attention to the ease with which capacity measurements of systems of mains may be made. Knowing the e. m. f. and the frequency it is only necessary to measure the current. The capacity in microfarads is then 1,000,000 times the amperes, divided by the product of volts, the frequency and 2π. If the tests are always taken at 1 e. m. f. and frequency, the scale of the ammeter may be marked to read directly in microfarads. He then gives a table and diagrams for the capacity losses in cables, giving the capacitv current. the apparent watts required by a cable of 1 microfarad, for various voltages between 1000 and 40,000, at a frequency of 50. The true watts of loss are made up first of ordinary copper loss or Joulean heat due to any charging current flowing in the conductor, to leakage, and to dielectric hysteresis. The first two parts are usually unimportant. The third, the loss from dielectric hysteresis, has been determined by him in a special case, and found to be 2226 apparent watts and 275 true watts per mile, at 2000 volts and a frequency of 100. When the cable is worked as intended at 6000 volts, 50 periods, the losses per mile will be 9726 apparent watts, and 1206 true watts per mile. This is on the assumption that the power factor is the same, namely, 0.124, at high pressures as at low, and that the loss in this instance was accurately determined. The dielectric loss is not preventible. It is always going on when the mains are energized—whether any power is being transmitted or not. He then discusses the following method by which a wattless current may be reduced and the power factor raised to unity or nearly so. An alternator supplies a circuit having capacity. A choking coil is placed in parallel with the capacity, and if it is so designed and adjusted that it takes a wattless self-induction current equal in amount to the wattless capacity current of the mains, the two will balance each other, and the generator will not have to produce any wattless current for either the capacity or the self-induction.—Lond, *Elec.*, Jan. 18.

Preventing the No-Load Loss in Transformers.—OSNOS.—An illustrated description of a switch which can be used with motors supplied from transformers. When a motor is switched out the primary windings of the transformer are also switched out, so that the no-load loss in the transformer is avoided. In the adjoining diagram, M is the alternating-current motor, K_1 and K_2 are the terminals of the high-voltage supply circuit, B is a local battery, U is a switch, S is a coil, K an iron core, W_1 and W_2 are inductionless resistances. When the motor is to be connected to the circuit, the switch U is turned to the contact 2, so that a current flows from the battery, B, through the coil, S, the iron core, K, becomes magnetic and attracts the iron arm, h. The upper arm of this lever, which consists of unmagnetic metal, is thus released and the iron core sinks down on account of gravity and acts upon the lever, h_1, so that the primary windings of the transformer are connected to the supply circuit. The switch, U, is then brought back to its middle position, shown in the figure. When the motor is to be disconnected the switch, U, is connected to the contact, 1, so that the coil, S, is supplied with an alternating current from the secondary windings of the transformer, the iron core is attracted upwards until it acts upon the lever, h_1, and breaks the primary circuit. The secondary winding then no longer has any current. The iron core sinks again until it is fastened by the upper unmagnetic arm of the lever, h. f is a spring exerting an upward force.—*Zeit. fuer Elek.*, Jan. 13.

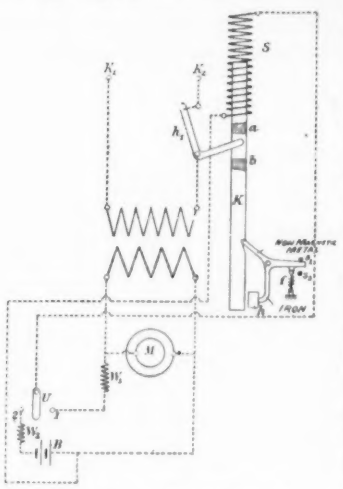


DIAGRAM OF CONNECTIONS.

Peterborough.—An illustrated description of this new British municipal lighting plant. There are two 4-pole dynamos, giving 150 amperes at 400 to 460 volts, at a speed of 460 r. p. m. There is also a combined balancer-booster set, consisting of two 4-pole balancers, rated at 50 amperes, 220 volts each, coupled together, and with two

2-pole battery charging boosters, rated at 60 amperes, 80 volts each, the whole running at 970 r. p. m. The battery consists of 240 cells, giving 325 ampere-hours at a discharge rate of 36 amperes and 240 ampere-hours at 60 amperes.—Lond. *Elec. Rev.*, Jan. 18.

Wires, Wiring and Conduits.

Aluminum Conductors.—J. B. C. Kershaw.—A paper read before the (Brit.) Inst. Elec. Eng. He gives a table showing that the price of aluminum has fallen, and the quality has improved with increasing output each year since 1890. Taking the specific gravity of copper and aluminum at 8.93 and 2.68, respectively, the conductivity at 100 and 59, the price per ton at $455 and $1,120, then $789, expended upon copper equals $1,000 expended upon aluminum for the same length of wire of equal carrying capacity. Aluminum is therefore the dearer metal of the two. If, however, a special price of 29 cents per lb. of aluminum is assumed, the $1,325 expended upon copper equal $1,000 expended upon aluminum, i. e., aluminum is cheaper. He refers to several installations of aluminum conductors in the United States and in Great Britain, and gives an account of tests which he has made during the last winter to determine the durability of aluminum and other metals under atmospheric exposure. He found that the aluminum wire at present sold for conducting purposes in Great Britain is not perfectly resistent to the atmospheric corrosion, and that in the atmosphere of a town where sulphurous acid gas exists as an impurity in the air, the metal is very badly attacked. In country districts or in small towns, where the impurities present in the air are reduced to a minimum, all metals experimented upon, seem to be fairly durable, but the slight pitting of aluminum which occurs, even in such an atmosphere, may prove serious, for by allowing the lodgment of small particles of foreign matter it may in time lead to the disintegration of the whole mass of metal. In the discussion which followed it was mentioned that Lord Kelvin is making experiments on a large scale. Gavey referred to experiments made by the post office, which had erected 15 miles of aluminum wire at the potteries near Hanley. The wire was handled well, but "within a fortnight of the erection of these wires a heavy gale of wind blew across the country and caused something like 8 or 10 breaks in the space erected. The wire employed weighed 78 lbs. to the mile. Its approximate diameter was 124 mils, its breaking strain 340 lbs., which being reduced to tons per square inch came out at 12.568 tons. It had stood 10 twists in 3 in. Its maximum resistance was approximately 6.158 ohms, and its specific resistance came out at 2.974 ohms." He also referred to the difficulty of soldering.—Lond. *Elec., Elec. Rev., Elec. Eng.*, Jan. 18.

REFERENCE.

Wire-Drawing.—An illustrated description of the Pieper system for wire mills, which is claimed to be far superior to older systems.—*L'Ind. Elec.*, Dec. 25.

Electro-Physics and Magnetism.

Producing High-Frequency Sine Currents.—Wien.—A description of an "alternating-current siren" for producing alternating currents of a frequency up to 17,000. He says that a frequency of 50,000 may perhaps be obtained with his instrument. The currents are very nearly sinusoidal, as none of the higher harmonics is more than 1 per cent of the fundamental wave. A disk of brass or wood contains a series of iron pieces arranged similarly to the holes in an acoustic siren. The disk is set into quick rotation by a motor. It rotates between the poles of an electro-magnet, the poles of which have a winding of thin copper wire. The frequency of the alternating current generated is proportional to the number of iron pieces and the speed. This e. m. f. thus generated is not at all sinusoidal, but the current is purified of the higher harmonics by electric resonance. For this purpose a condenser and choking coils are inserted in the circuit. He shows, analytically, how they operate. This instrument is well suitable for experimental purposes and for measurements of electromagnetic quantities and their variation with the frequency.—*Phys. Zeit.*, Jan. 19.

Pressure and Temperature in the Electric Spark.—Haschek.—He has "supplemented his own and Mache's experimental work on the pressure and temperature within the electric spark by a theoretical treatment based upon the conceptions of Schuster. It is supposed that at the beginning of the discharge certain minute particles, whether of air or of electrode material, are projected with a great velocity from both electrodes. Their initial velocity between zinc poles would be about 3000 m. p. s., but owing to the resistance of the gas traversed, this velocity would fall to about 400 m. p. s. by the time the particles are 4 mm. away from the electrodes. The collisions which bring about this retardation also produce a rise of temperature, and the retardation itself produces an accumulation of particles which gives rise to an increase of pressure. Both pressure and temperature show a strictly corresponding distribution. With five large Leyden jars and a spark-gap of 8 mm. the maximum temperature would be some 1000 degs. in the centre, and the maximum pressure would amount to some 28 atmospheres. This is of the same order as the pressure determined experimentally."—*Ann der Physik*, No. 12; abstracted in Lond. *Elec.*, Jan. 11.

Roentgen Rays and Coherers.—Jensen.—An account of an investigation of the fact that Röntgen rays often exert an apparent influence upon the resistance of coherers. When he introduced a Röntgen tube into the secondary circuit of an induction coil, a Kohl detector for wireless telegraphy showed an immediate response, which occurred even after taking all kinds of precautions against stray sparks, but was entirely obviated by enclosing the Röntgen ray tube in a box with an aluminum window, through which Röntgen rays could freely penetrate, so that this effect could not be due to Röntgen rays alone. The real cause of the effect was found to be the appearance of "gliding sparks" inside the Röntgen tubes themselves. These gliding sparks play about the metallic conductors within the tubes, and appear to glide to and fro along them. The appearance or non-appearance of the response depends upon the position of the point at which the sparks appear with respect to the coherer. Preliminary experiments with Becquerel rays show that they have no influence upon coherers.—*Phys. Zeit.*, Jan. 5; abstracted in Lond. *Elec.*, Jan. 18.

Motion of an Electrified Particle.—Riecke.—An investigation of the case in which an electrified particle or ion moves in a magnetic field upon which an electric field is superimposed, both fields being uniform. The result of analysis shows that the particle moves along a cycloidal curve. The results have a bearing upon the phenomenon in the vicinity of the cathode, the changes in luminous layers under magnetic influence, and the theory of the aurora.—*Phys. Zeit.*, Jan. 5; abstracted in Lond. *Elec.*, Jan. 18.

Specific Inductive Capacity of Dielectrics in a Magnetic Field.—Roberts.—A brief description of some preliminary experiments made to ascertain whether the presence of a magnetic field has some effect on the specific inductive capacity of a dielectric. The experiments were based on the fact that if a condenser be charged and insulated, any change in the specific inductive capacity will manifest itself as a change in the potential difference between the coatings. The results, so far obtained, are negative.—*Phys. Rev.*, Jan.

Remanent Magnetism.—Holitscher.—An account of an investigation of the remanent magnetism in an iron ellipsoid. "The remanent magnetic moment is distinctly dependent upon the time during which the magnetizing force is applied. It takes from one minute to three minutes to have its full effect in the case of fields varying from one unit to six units. This is all the more strange as the temporary magnetization is practically independent of the duration of magnetization. When the direction of the field is kept constant, successive impulses increase the remanent magnetism, the increase becoming slow after the first 10 impulses, but continuing to be perceptible until some hundred impulses have been given. On the other hand, when opposite magnetizations are induced in succession, the remanent magnetism remains sensibly the same."—*Ann. der Physik*, No. 12; abstracted in Lond. *Elec.*, Jan. 11.

Terrestrial Magnetism.—This issue contains a review by Nippoldt, of the development and the present status of the theory of the earth's magnetism. A note in French, by Morize, on a cause of error in the determination of the magnetic declination. A note, by Luedeling, referring to a communication of Moureaux on the periodicity of the disturbances of the horizontal intensity, observed at the observatory of Park St. Maur. Some supplementary remarks by Liznar on his former paper on the measurement of the horizontal intensity of the terrestrial magnetism by means of the magnetic theodolite. A note, by Van Bemmelen, on the magnetic "postturbation" and the current-vortices of Schmidt, and an account by Elster, of measurements of atmospheric electricity, made during the total eclipse on May 28, 1900, in Algiers. A reply by Sutherland on the criticism of Gilbert of his theory of the earth's magnetism, mentioned before in the Digest, and a biography, with portrait, of Prof. Schuster.—*Terr. Magnetism*, Sept.

REFERENCES.

Diminishing the Resistance by Cold.—Mewes.—A long article in which he gives theoretical notes on the phenomenon found by Dewar and Fleming that the electric resistance diminishes considerably with

decreasing temperature, and on the method of insulation, based upon this fact and recently patented by Tesla.—*Elektrochem. Zeit.*, Jan.

Polarization with Alternating Currents.—OLIVERI.—An account of a theoretical and experimental investigation. It seems that in the case of small polarization, a voltameter, inserted in an alternating-current circuit, behaves like a capacity.—*Phys. Zeit.*, Jan. 12.

ELECTRO-CHEMISTRY AND BATTERIES.

Storage Battery.—WADE.—An article on "The present and future of accumulators." He remarks that while the active materials constitute the most vital part of a storage cell, and the one which its success or failure almost entirely depends upon, yet the precise methods used for their production are known to very few besides the manufacturers. He gives a few notes on the Planté formation and on rapid formation processes. He says that substantial improvements may be effected in lead cells by largely increasing the molecular porosity of their active material. He prophesies that "the lead cell of the future will contain electrodes of much greater thickness than those now used—perhaps an inch or more. They will consist of a mass of exceedingly porous active material containing sufficient electrolyte for its complete discharge within its pores, and a current collector or support ramifying to all parts of it. These plates will be packed close together, with only a porous separator sheet of some kind between them, and will practically fill their containing box." Regarding the zinc-copper oxide alkaline combination with its low e. m. f., but large watt-hour output for weight, owing to its enormous ampere-hour capacity, he says that "so long as the copper oxide cannot with certainty be prevented from passing into solution when charging, this alone will be quite sufficient to destroy all chances of its success." The zinc-lead peroxide acid cell has two special merits, a large ampere-hour output for weight and a high e. m. f., both being due to the zinc electrodes, as also are its two chief failings, i. e., the difficulty of maintaining an efficient deposit of zinc, and of preventing it from passing back into solution by local action on open circuit.—*The Electrochem. and Met.*, Jan.

Electrolytic Alkali Process.—A note on the Hargreaves-Bird electrolytic alkali process. It is said that the large works using this process will be ready to manufacture in April next. The Farnworth experimental plant is still running with satisfactory results, alkali equivalent to 57.5 per cent of soda ash being obtained direct from the cell liquors by boiling them down. The current efficiency of the cell averages 93.5 per cent. At the St. Gobain Company's works at Chauny, near Paris, the small installation of the Hargreaves cell has ceased running, since it has been found that the cells were too small for economic manufacturing operations, and the generating machinery has also been giving some trouble. It is now intended to enlarge the plant at Chauny, and to erect cells five times the size of those originally put down. This enlargement is, however, postponed until after the commencement of manufacturing operations at Middlewich in order to profit by the experience gained there.—Lond. *Elec.*, Jan. 11.

Aluminum.—LEEDS.—An article on the prospects of the aluminum industry. After some general remarks regarding the manufacture of aluminum, he briefly discusses the various uses of aluminum. It has proved very valuable as a means of preventing faulty castings of iron, steel and brass. The Goldschmidt process of using the energy stored in elemental aluminum, for the reduction of various refractory ores, is still in its infancy. The other Goldschmidt process of welding iron and steel is more capable of being appreciated. Aluminum is already finding its way largely into the construction of automobiles, etc. It is claimed to have been shown in practice that the use of aluminum in large kitchens to replace tinned copper, roughly halves the fuel bill. Another use consists in the construction of engineers' working patterns from aluminum. The construction of the exposed parts of sea-going ships of aluminum plates, and the use of aluminum wires for uninsulated electrical conductors, are briefly noticed. The question of the durability of aluminum in damp air or seawater has not yet been definnitely settled.—Lond. *Elec. Rev.*, Jan. 11.

REFERENCES.

Manufacturing Storage Battery Plates.—An illustrated description of a system, patented by Levermann, for casting storage battery plates. At the bottom of the ladle which contains the melted lead, he places a valve with an exchangeable nozzle, so that he can get a stream of lead of any desired thickness.—*Centralblatt f. Accum.*, Dec. 15.

Elastic Materials in Storage Batteries.—A discussion of several arrangements which have been made to keep the active mass fixed, by means of elastic substances, as ebonite. The patents of Brown and Vaughan-Sherrin are discussed and the results of tests of a storage battery of the latter type are given.—*Centralblatt f. Accum.*, Jan. 15.

Sanitary Regulations for Storage Battery Manufactories.—HEFFTER.—An article in which he reproduces the very strict regulations made by the German Government since 1898, for the installation of factories in which storage batteries are made, in order to prevent the danger of lead poisoning. He also gives statistical data showing that these regulations have been successful.—*Centralblatt f. Accum.*, Dec. 15.

Electric Bleaching.—ENGELHARDT.—A long paper criticizing several points in the paper of Oettel, noticed in the Digest, Jan. 5. He endeavors to show that the Kellner apparatus for electrolytic bleaching is cheaper and more economical than the apparatus of Haas & Oettel.—*Zeit. f. Elektrochemie*, Jan. 3.

Deposition of Metals from Mixed Electrolytes.—LEHFELDT.—An account of the later researches, especially of Le Blanc, on this subject, based upon the electrolytic dissociation theory.—*The Electrochem. and Met.*, Jan.

Ferro-Titanium.—DUNLAP.—An article on the manufacture of ferro-titanium at Niagara Falls and its use in steel making.—Lond. *Elec. Rev.*, Jan. 18.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Capacity in Alternating-Current Working.—AYRTON.—A communication referring to the paper of Mordey abstracted in another part of the Digest. He refers to the following method for ascertaining the outside limiting value of the dielectric hysteresis in a cable which is entirely free from the possible chance of serious error that might arise from using a wattmeter or integrating wattmeter with a circuit possessing an extremely low power factor. First calculate the self-induction which the inductive shunt to the cable should have in order that the alternator current may be a minimum. This is given by a simple formula. Next calculate what will be the alternator-current with such an inductive shunt, when using his "sine-curve alternator," if there be no dielectric hysteresis. This current may be *a* ampere. Thirdly, make the experiment with the cable shunted with an inductive shunt made without iron, to have this best value of the self-induction. The alternating current observed may be *b* ampere. Then an outside limit of the current due to dielectric hysteresis is obviously $b - a$ ampere, and an outside limit of the power spent in dielectric hysteresis in watts is this difference multiplied with the volts.—Lond. *Elec.*, Jan. 18.

REFERENCES.

Standard Cells.—JAEGER.—A supplement to his former serial. He deals with the investigations of the Clark cell by Barnes, and with the researches by Cohen, by which the theory of standard cells has been brought into good agreement with the thermo-chemical data; also with later investigations, especially by Cohen and Jaeger, on the usefulness of the cadmium cell as a standard cell. These were noticed before in the Digest.—*Centralblatt f. Accum.*, Jan. 1, 15.

New Interrupter.—HIRSCHMANN.—An illustrated description of a new interrupter, which involves the use of mercury, but not as a conductor, as its function is that of amalgamating the two copper surfaces forming the contacts. The interrupter works noiselessly and well in an accumulator circuit or a 110 or 220-volt supply circuit.—*Phys. Zeit.*, Jan. 5; abstracted, with illustrations, in Lond. *Elec.*, Jan. 18.

Phase-Turning Apparatus.—DUDDELL.—A communication referring to the paper of Campbell "on a phase-turning apparatus for use with electro-static voltmeters" (Digest, Jan. 26). He points out some limitations to the methods therein proposed.—Lond. *Elec.*, Jan. 18.

Volt and Ammeter.—MENGES.—An abstract of a French Phys. Soc'y paper, in which he describes a galvanometer of the Deprez d'Arsonval type, which can be used as ammeter or as voltmeter, the magnetic field being adjustable.—*L'Ind. Elec.*, Dec. 25.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Electric Signals on Board Ships.—DARY.—An illustrated description of a system of signals, devised by Vialet-Chabrand, and in use on several French ships. Its principle is as follows: The transmitter is a simple commutator by which different circuits can be closed, which contain lamps and bells at both the transmitting and receiving stations. By closing a certain circuit by means of the commutator, the lamps in this circuit are lighted and the bells made to ring. At the receiving station the signal is thus received and the attendant there then turns a commutator so that the circuit is broken and the

transmitting station knows that the signal has been received. The current is furnished by a battery.—*L'Elec.*, Dec. 29.

REFERENCES.

Central-Battery Telephone System.—Andre.—His. Internat. Elec. Congress paper, in which this system is described, together with other improvements in telephone exchanges. The arrangement of the lines is described in detail, the old and the new systems are compared, and an account is given of the results obtained, especially in the United States.—*L'Ind. Elec.*, Dec. 25.

Long Distance Telephony.—Price.—The conclusion of the mathematical article (Digest, Jan. 26), in which different methods of improving long distance telephony by means of inertia of induction coils in series or of leakage in the line, are discussed.—Lond. *Elec. Rev.*, Jan. 18.

Miscellaneous.

REFERENCES.

Biographical.—A long account by Belok of the life and work of the late electro-metallurgical engineer, Carl Hoepfner.—*Zeit. f. Elektrochemie*, Jan. 10.

Assistance in Accidents.—Charas.—An illustrated paper read befort the Elektrotechnical Society of Vienna on the best way to render immediate assistance in case of an accident due to an electric shock.—*Zeit. fuer Elek.*, Jan. 6.

Paris Exposition.—The fourteenth part of the illustrated serial, dealing with electrically driven machine tools and pumps which were exhibited.—Lond. *Elec.*, Jan. 18.

The first part of an illustrated article on electro-chemistry at the Paris Exposition. A table is first given to show that one must not rely too much on the general impression produced by the exhibits of a "universal" exhibition. This table shows the value of annual output of calcium carbide in the different countries and the number of firms exhibiting. For instance, the United States heads the list of value of annual output with $4,500,000, France is next with $2,625,000; no American firms had exhibited, while 14 French firms had. Under electro-deposition, descriptions are given of the Elmore and Secretan process for making seamless copper tubes, of the Cowper-Cowles copper process with a current density as high as 200 amperes per square ft., of the Rieder apparatus for electrolytically etching steel plates, and of the Siemens & Halske process of gold recovery. Notes are also given on the calcium carbide manufacture, on the aluminum manufacture, on the electrolytic manufacture of alkali and bleach, and on electric furnaces and products manufactured thereby.—*Electrochem. and Met.*, Jan.

Bainville.—An illustrated description of the Batault alternating current wattmeter, which was mentioned before in the Digest.—*L'Elec.*, Dec. 29.

Reyval.—An illustrated description of the accumulator of the Chloride Electrical Storage Syndicate, Limited, of Manchester.—*L'Eclairage Elec.*, Dec. 29.

Heim.—Some general notes on the exhibits of storage batteries. The general types are becoming more and more alike, the differences between them disappearing. In Europe the following practice has become practically the standard. In railway plants, in street cars driven with accumulators, as also sometimes in lighting plants, Planté plates are used as positive and the pasted Faure plates as negatives; in many lighting plants both plates are of the Faure type, and are of heavy construction. For automobiles, thin, light pasted grids as positive and negative plates are used.—*Centralblatt f. Accum.*, Jan. 1.

An illustrated article on direct current apparatus, exhibited by the United Electric Company, of Vienna.—*Zeit. fuer Elek.*, Jan. 6, 13.

An illustrated article on three-phase induction motors, exhibited by the United Electric Company, of Vienna.—*Zeit. fuer Elek.*, Jan. 13.

Soulier.—An illustrated description of the Rieter regulator for turbines with electric brake.—*L'Ind. Elec.*, Jan. 10.

Girault.—A well illustrated description of alternating-current machines exhibited by Schneider & Co. A 700-hp two-phase alternator, running at 600 r. p. m. and giving either 40 or 80 or 120 or 160 volts. A 105-hp, 3000-volt, three-phase alternator, and several types of three-phase and single-phase induction motors.—*L'Ind. Elec.*, Jan. 10.

Directory of Electrical Societies, Etc.

American Street Railway Association. Next meeting, New York, Oct. 17-20, 1901.

New York Electrical Society. Next meeting, College of the City of New York, Feb. 14. Paper by Kempster B. Miller, entitled "Modern Telephone Engineering."

Association of the Edison Illuminating Companies. Next meeting, Sept. 10, 1901.

New Book.

Technical, Industrial and Commercial Vocabulary. English, French, German. By E. Hospitalier. Paris: L'Industrie Electrique. 316 pages. Price, 6 francs.

This admirable compilation is arranged on an ingenious plan, which cannot be too highly commended. The words in the three languages—English, French and German—are not in separate sections, but are intermingled in alphabetic order. The language to which a word belongs is indicated typographically in the translation, the English words being printed in italics, the French words in small capitals, and the German words in ordinary Roman type. When a word is followed by no translation, the reader will understand that it is used in all three languages. If a word is followed by one translation only, it is the same in two of the three languages. Space is still further saved in case of words having the same root in the two or three languages, by printing the root but once, the various terminations being bracketed and in the respective type of the languages to which they belong. By this typographical means and use of some other devices, numerous repetitions are avoided and much space saved, the result being the combination in one small volume of three distinct vocabularies which, when in separate form, are subject to the disadvantages of being inconvenient to handle and expensive. As might have been expected of an author of the competency of Prof. Hospitalier, with respect both to a knowledge of the languages concerned and the electrical art and science, the work is thoroughly reliable, and is likely to become the standard electrical word book of the French, English and German languages.

A Novel Method of Operating Arc Dynamos.

The problem of operating arc dynamos connected together at the shafts, and driven from a pulley at one end—the pulley in this way operating 3, 4 or 5 machines—has been frequently discussed by engineers, but nothing has hitherto come of it because it was considered necessary to provide means by the use of clutch couplings, hollow shafts, etc., of disconnecting any one of the dynamos without interfering with the operation of any of the others. As an arrangement of this kind would be delicate, complicated and very expensive, the idea was abandoned.

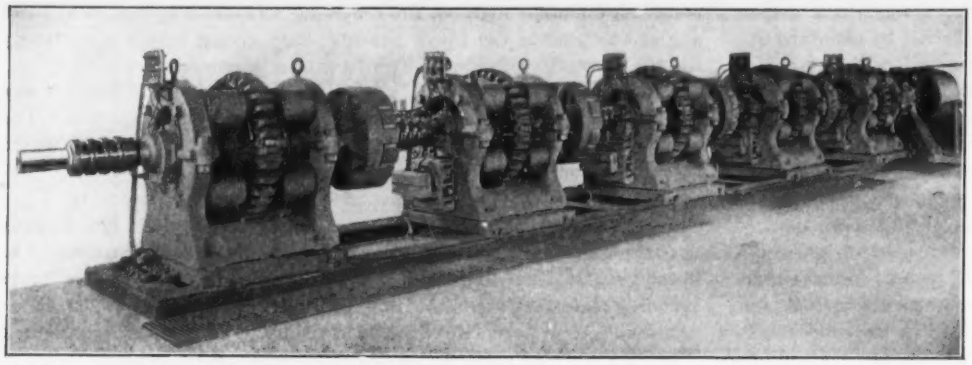
Mr. Ellicott, city electrician of Chicago, however, found it necessary to solve such a problem, because of the peculiar conditions in the Waller Station at Englewood, where the building was about 30 ft. wide and 125 ft. long. To install arc dynamos in the usual way would fill the room with jack shafts and belting. Mr. Ellicott finding that in three years none of the 11 large dynamos in service has been shut down, determined to risk running several dynamos on a single shaft. Mr. Ellicott's installation consisted of five Brush arc dynamos, coupled together at the shaft ends by the use of rubber buffer couplings. The only provision made for the cutting out of a particular dynamo in case of trouble was by shutting down the whole line, lifting the top part of the fields off, and lifting out the armature, and putting in its place a piece of shafting for the purpose of completing the connection between the dynamos on either side of the disabled machine. To make a change of this kind would probably occupy about 15 or 20 minutes.

The Brush arc dynamos used in this case are standard machines, with shafts of greater diameter than usual to stand the increased strain, and a few minor changes because of increased diameter of shaft. By use of the rubber buffer couplings, accurate alignment of the machines is not important, and at the same time the chance of any electrical connection between two machines at the coupling is reduced to a minimum.

This method of operating dynamos was not approved by engineers whom he consulted when originally suggested by Mr. Ellicott, but he felt from his own experience in the operation of arc dynamos, he was entirely justified in carrying out the plan, with results that have been exceedingly gratifying and satisfactory.

The five machines have been operated under full load, and are run with the greatest possible success. They operate smoothly, noise-

lessly and without vibration. From the accompanying cut it will be seen that aside from the economy of operation by reason of belt losses and economy in floor space, the general appearance of the central station is markedly improved. Mr. Ellicott believes that it is only a question of time when all the large stations operating arc dynamos will adopt this plan.



FIVE ARC DYNAMOS COUPLED TOGETHER AT THE SHAFT ENDS.

Operation of Cranes by Induction Motors.

In an article printed in these columns last week, descriptive of the induction motor power equipment of the Union Malleable Iron Company, of East Moline, Ill., an illustration is given of a traveling crane operated by variable speed induction motors. We are now enabled to give some further details of this interesting application of the polyphase motor.

The principle of variable speed operation consists in supplying the motors with variable e. m. f. by means of "auto-converters," which are transformers giving practical parts of the total available e. m. f., and used principally for starting and slow speed work.

There are four three-phase induction motors on the crane, two of 20 hp, one of 5 hp and one of 50 hp, their speeds being from 830 to 1100 r. p. m., dependent upon the position of the "auto-starters." They are also arranged to operate at from 100 to 400 volts, which gives a further and wide range of speed.

For the control of the motors, the standard Westinghouse alternating-current controller is installed, two types of which are shown in the accompanying illustrations. The controllers are carried on the car with which each crane is equipped, and are operated by a single attendant, the various motions of the crane and lifting gear being under the control of a number of switch handles placed conveniently on the car.

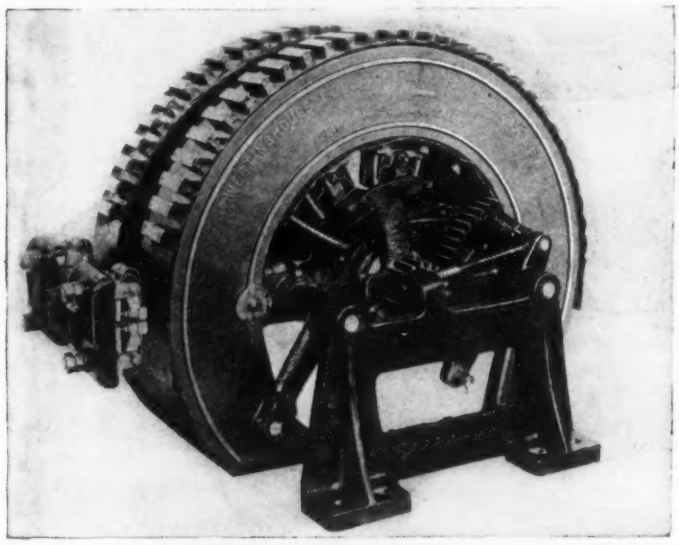


FIG. 1.—ALTERNATING-CURRENT CONTROLLER.

As implied previously, these controllers are designed for regulating and reversing variable speed polyphase motors. They are noncombustible, have a large number of steps for regulation, and are conveniently operated by a lever which is connected to the controller by a link. They are used in connection with a pair of auto-converters, which give the various steps in voltage.

In cases where several controllers are placed in close proximity to each other, such as in a crane cage, one pair of auto-converters will answer for all the controllers, the size depending on the demands made by the controllers considered collectively. It is easily seen that by this arrangement, in cases where heavy demands are not made by several controllers at the same time, comparatively small auto-converters will be sufficient for all the controllers. Fig. 2 is a type for use with alternating-current motors of large capacity. Its construction and method of operation is the same as in the smaller sizes, but it has more steps, the total number being 30. This latter is designed for use with motors up to 50-hp capacity, on either 100, 200 or 400-volt circuits.

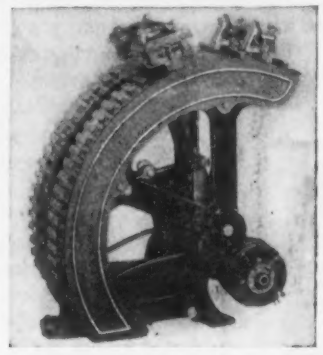
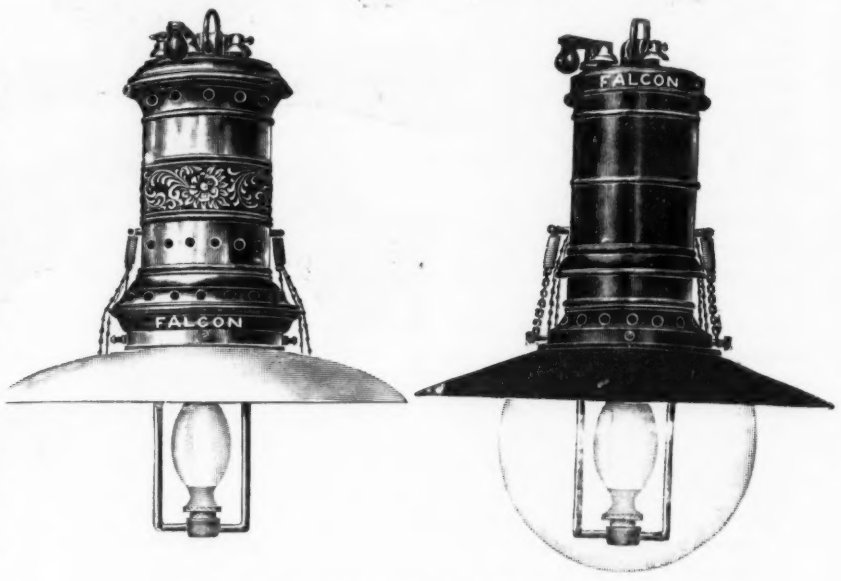


FIG. 2.—ALTERNATING CURRENT CONTROLLER.

New Designs of Falcon Arc Lamps.

To satisfy the increased demand for its arc lamps, the Falcon Electric Manufacturing Company, of New York City, during the last few weeks has added several new designs of arc lamps to its line, two of which are illustrated herewith. One is a brass lamp with opal reflector, for interior lighting, the other is intended for outdoor use. Both lamps, as can be seen from the cuts, are equipped with reflectors so as to direct as much light as possible to the floor or ground where it is required. Besides these two designs and the older ones, which have been manufactured for sometime, the black weather-proof lamp can be furnished with an opal reflector or with a metal reflector, but without an outer globe.



FIGS. 1 AND 2.—FALCON ARC LAMP.

The mechanism of all these lamps is identical. Its extreme simplicity and the method of making the joints of its moving parts, insure reliability, and result in very close regulation and steadiness of light. The "Falcon" arc lamps are manufactured at present for all constant potential direct-current circuits, and prompt shipments from stock can be made. The Bulletin No. 7, just issued, fully describes all these various designs, and will be mailed to any intending purchaser upon application.

Western Electric Fans for 1901.

The Western Electric Company's fan motors for the season of 1901 are, excepting some slight changes in details, practically the same as those of last year. The fact that little or no change has been found necessary indicates that these devices have reached a degree of perfection that entitles them to a place in the list of standard apparatus. The company is making desk, bracket and ceiling fans for operation on circuits of 110, 220, 250 and 500 volts.

The construction of the desk fan is clearly shown in Fig. 1, which is a cross-sectional view. The outer surface is spherical and the journal nicely fitted into the bearings, which are bored cylindrically. The gland of the oil cup, marked *B*, containing a felt wick, passes through without touching the bearing seat and fastens into the journal. The gland of the oil cup serves at the same time to steady the journal while leaving it perfectly free to move in any direction. The oil cup is provided with a large oil chamber which is filled with heavy cylinder oil, and one oiling will

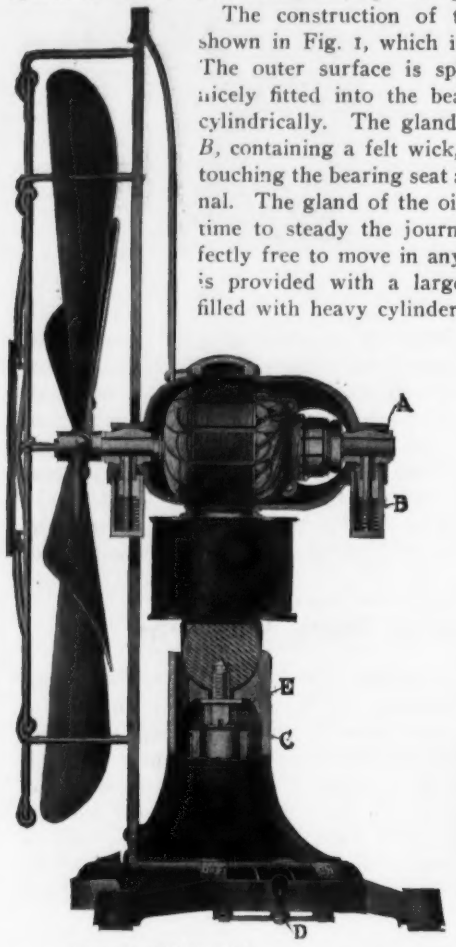


FIG. 1.—DESK FAN.

under ordinary conditions last an entire season. The magnet frame is a drop forging, and is held to the base by the slotted bolt, *E*, and the motor may be easily removed from the base by unscrewing this bolt. The armature is of the iron-clad type, and the commutator is made of the best hard-drawn copper segments separated by mica insulation.

In these motors the commutator is always open to view, and injurious sparking of the brushes may be corrected before it has done irreparable damage to the commutator. The brushes are of specially prepared graphite and self-adjusting. By means of the switch, *D*, the motor may be operated at three different speeds, the position that the switch must occupy for any speed being marked upon the base of the motor. The speed is reduced by throwing more or less resistance into the circuit. The rheostat, *C*, consists of a porcelain spool upon which is wound German silver wire, which is carefully insulated with asbestos and mica. All switches are mounted upon porcelain bases.

The 220 and 500-volt motors are designed to be connected directly to the service wires, no series resistance being placed in the motor to cut down the voltage.

The 500-volt motors are provided with an added precaution of a double pole quick break switch placed beneath the motor. The motors are designed for continuous running at any of the three speeds without sparking and without heating to any appreciable extent.

In Fig. 2 is shown the construction of the standard ceiling fan. The self-aligning bearings marked *H* are similar to those used in the desk fan motors, and are turned out of the finest quality of babbit metal, the outer surface being spherical and nicely fitted into the bearings which are bored cylindrically. The upper journal is supported in a similar manner, the centering screws being placed at right angles to those in the lower bearing, thus giving ample opportunity for the journals to be brought into proper alignment.

Below the upper journal is a small oil pan intended to prevent any oil that may run from the journal getting into the armature. The upper part of the fan hub marked *L* is also made cup-shaped, which catches any oil that may drip from the lower bearing. These two precautions effectually prevent any oil dripping from the motor.

The armature is of the same type as that of the desk fan, already described, and the commutator is in all respects the same. The brushes, also, are identical, and the machine likewise has three speeds. Referring to the illustration, Fig. 2, the switch, *O*, is mounted on a porcelain base, and is used as a speed controller. The rheostat, marked *D*, fastened to the upper bearing bracket, marked *F*, consists of a porcelain spool wound with the best German silver wire.

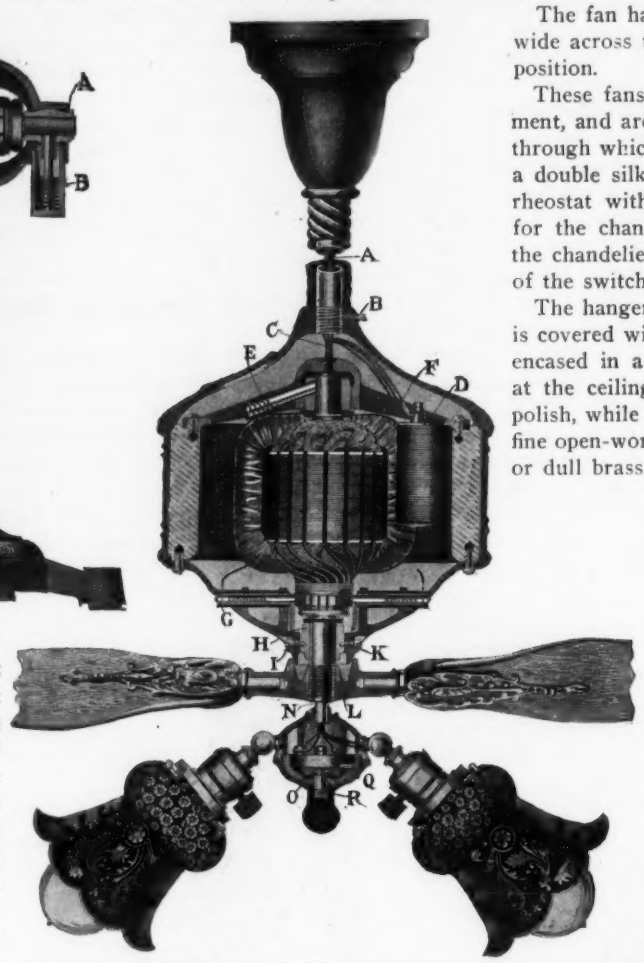


FIG. 2.—SECTION OF CEILING FAN.

The fan has a sweep of 60 in. and the blades are 8¾ in. wide across the face. The blades are fixed in a permanent position.

These fans are made with or without chandelier attachment, and are provided with cold-drawn hollow steel shaft through which an iron pipe marked *N* runs, which contains a double silk and rubber covered cable, *C*, connecting the rheostat with the switch. This cable also contains leads for the chandelier lights. When a fan is not used with the chandelier attachment these leads are coiled in the top of the switch box.

The hanger pipe, which is fastened to the motor casting, is covered with brass tubing of rope design. The motor is encased in a highly ornamental covering, the connections at the ceiling being concealed by a canopy having a fine polish, while the lower part of the motor is made of a very fine open-work casing. The motors are made with a bright or dull brass finish, or oxidized copper as desired.

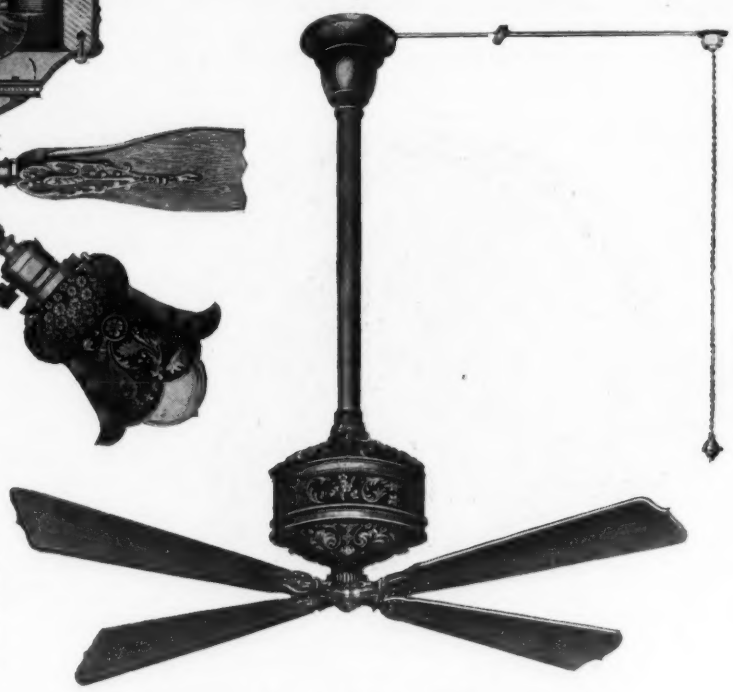


FIG. 3.—CEILING FAN.

Fig. 3 shows a ceiling fan without chandelier attachment. It is started and stopped by means of a pendant switch, which may be placed at any convenient point.

The Western Electric Company also manufactures alternating-current desk and ceiling fan motors of the induction type. The fan motors of both the direct and alternating-current types are said to be efficient machines, giving a great wind output for a low consumption of current.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The rates for call money last week ranged from 1½ to 2 per cent, while for time loans the quotations were 3@3½ per cent, according to time and quality of collateral. Funds were freely offered, but borrowers were disposed to hold off. The closing rates for commercial paper are 3@3½ per cent for prime double names and 3½@4 per cent for choice single names. In the stock market advancing tendencies were renewed. Among the tractions and electric stocks some irregularity was exhibited. General Electric ranged between 188¼ and 192½, closing at 190½; this being a net gain of 2½ per cent. The sales for the week were 7315 shares. Brooklyn Rapid Transit lost 1 point, the sales aggregating 74,115 shares. Metropolitan Street Railway fluctuated within narrow limits—161 to 163¾—but closed with a net gain of 1¼ points. Western Union made a net gain of ¾ of a point. In the market for outside securities there was a general decline in quotations, and the volume of business transacted was smaller than during several months in the last half of 1900. The decline in market values during last month in the outside list is well distributed among the industrial, transportation and mining stocks. Sixteen of the 25 securities included show an average net loss of approximately 1¾ points, while 9 stocks have enjoyed advances averaging 2⅜ points. Following are the closing quotations on Friday at New York, Boston, Philadelphia and Chicago, the exchanges being closed on Saturday:

NEW YORK.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Gen. Electric	188	190½	Elec. Veh.	16	15
Bklyn Rap. Tran.	78	77	Elec. Veh., pfd.	30	30
Met. St. Ry.	162¼	163½	Gen. Car.	4⅜	2⅞
Am. Tel & C.	96	—	Ill. Elec. Veh. Tran.	¾	¾
West. Un. Tel.	83	83¾	N. E. Elec. Veh. Tran.	2¾	2⅞
Am. Dist. Tel.	—	—	N. Y. Elec. Veh. Tran.	4½	4¼
Com. Cable	—	—	Tel. & Tel. Co. of Am.	4	4
Elec. Boat	29	27	Hud. Riv. Tel.	117	117
Elec. Boat, pfd.	52	53	N. Y. & N. J. Tel.	174	174

BOSTON.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
New Eng. Tel.	—	—	Erie Tel.	57	58½
Mex. Tel.	2¼	2½	Gen. Elec., pfd.	160	*162
Westing. Elec.	*55	55	Am. Tel. & Tel.	161½	163
Westing. Elec., pfd.	—	—	Boston Elec. Light	—	—

PHILADELPHIA.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Elec. Stor. Bat.	77	72	Phil. Elec.	7⅛	7⅛
Elec. Stor. Bat., pfd.	80	72	Pa. Elec. Veh.	2	2
Elec. Co. of Am.	8	8⅛	Pa. Elec. Veh., pfd.	1	1
Gen. Elec. Auto	—	—	Am. Rys.	31½	32½

CHICAGO.

	Jan. 26.	Feb. 2.		Jan. 26.	Feb. 2.
Chicago Edison	150	150	Chicago Telep. Co.	255	255
Chic. City Ry.	255	255	Union Traction	11	11¾
Nat'l Carbon	15¾	15½	Union Traction, pfd.	49	49½
Nat'l Carbon, pfd.	84	84	Northwest Elev. Com.	27	*31

* Asked.

SOUTHERN NEW ENGLAND TELEPHONE.—The annual meeting of the stockholders of the Southern New England Telephone Company was held last week, when President Morris F. Tyler submitted his annual report, showing the business transacted during the past year. The year just closed has been a satisfactory one, and the report shows the wonderful growth of the telephone business in Connecticut. The total assets of the company are $3,660,839.54; the net earnings for the year amounted to $167,660. The amount of dividends paid was $150,660, and the amount carried to surplus is $17,000. During the year 2581 stations were added to the system, with a total increase of annual rentals of $49,580.97. President Tyler says that the business of the company has somewhat outgrown its equipment in the larger exchanges and the management is considering enlarging its premises in New Haven and Bridgeport. Twenty years ago there was $125,000 of capital invested in the business. To-day there is $3,513,000 of capital invested, of which $2,760,000 is represented by stock and $753,000 by bonds.

CHICAGO ELEVATED EARNINGS.—President Leslie Carter's report on the operations of the South Side Elevated Road in 1900, equipped with the Sprague multiple unit system, submitted at the annual meeting of stockholders, shows net earnings for the year amounting to $538,235, and a surplus, after interest and dividend payments, of $197,720. The net earnings are equivalent to 5 per cent on the outstanding stock of the company. A somewhat larger percentage than this could have been shown easily, but the policy of the management is to charge everything in the way of repairs and renewals to operating expenses, and to charge nothing to construction that does not strictly and legitimately belong to that account. In pursuance of this policy in the last two years there has been charged to operating expenses about $500,000, some of which might properly have been carried in accounts, and which would have produced a more favorable looking balance sheet.

CONSOLIDATION AT LANCASTER, PA.—A big deal was practically closed last week for the consolidation of the Conestoga Traction Company, the Lancaster Railway Company, the Lancaster Gas Light & Fuel Company, and the Edison Electric Light Company. These represent an aggregate of about $5,550,000 capital. The statement was authorized that William B. Given, of Columbia, and Samuel R. Shipley, of Philadelphia, both of the Conestoga Company, have become the owners of more than a majority of the shares of that company, and that they will incorporate the Lancaster County Light & Power Company, which will take and operate all lines of the traction company and the plants of the two light companies. The Conestoga Traction Company operated 86 miles of electric railway in Lancaster County. It is said that William B. Given, president of the Conestoga Company, will be the president of the new company.

NORTH AMERICAN COMPANY.—At a meeting of the stockholders of the North American Company J. P. Morgan & Co.'s interests were represented on the board by the election of Robert Bacon, he being one of the three new directors added to the board. About two-thirds of the entire issue of stock was represented at the meeting, and it was unanimously decided to accept the readjustment plans provided by the board reducing the capital stock of the company from $50,000,000 ($40,000,000 of which is issued) to $12,000,000. The other two new members of the board were Charles F. Pfister, of Milwaukee, and Charles A. Spofford, representing the Villard estate. The following is the board elected: George R. Sheldon, Charles W. Wetmore, William Nelson Cromwell, Robert Bacon, Edmund C. Converse, Charles A. Spofford, J. H. Herrick, J. R. Delamar, of New York; Henry C. Payne, Charles F. Pfister, John I. Beggs, of Milwaukee, and A. Q. Keasbey, of New Jersey.

AMERICAN STEEL AND WIRE.—By the meagre annual balance sheet of the American Steel & Wire Company profits are shown to have been nearly cut in half—amounting to $8,002,129 in 1900, against $13,362,530 in 1899. After charges for depreciation and bad debts—1,000,000 last year, against $1,200,000 in 1899—net profits available for dividends were equal to 8¼ per cent on the common shares, against 18¾ per cent a year ago. This heavy decrease in receipts the executive committee attributes chiefly to the slump in business in the first quarter of the year, when the company was overstocked with pig-iron, billets and raw material contracted for at high prices. But the directors state that business in the last half of the year improved, and now they have announced an advance of $2 per ton in manufactured products.

CHICAGO'S FRANCHISE FIGHT.—Chicago has on hand the most important mayoralty campaign in 25 years. The great issue is the street railway franchises. In 1902, 1903 and 1904 expire nearly all the important franchises. The railway companies desire franchise renewals for at least 20 years, and for 50 years if possible. They are adverse to paying over 3 per cent on gross earnings, and this they are willing to pay only on main lines. The Democrats now insist on franchises not longer than 20 years, 10 per cent compensation on gross earnings of both main and suburban lines, and eventual municipal ownership.

AMERICAN TELEPHONE.—It is said that General Counsel F. P. Fish, of the American Telephone & Telegraph Company, is the choice of a majority of the directors of the telephone company for the presidency, to succeed the late President Hudson. The choice is said to lie between Mr. Fish and President Cutler, of the New York Telephone Company. Mr. Fish has a very large and lucrative practice, and would need considerable inducement to relinquish the profession of which he is one of the most brilliant and uniformly successful members.

SPENCER TRASK & CO. have issued an admirable little compilation of financial data, including statistics of railroad stocks and bonds, street railway and miscellaneous securities, industrial stocks and bonds, with special data as to preferred. The range of quotations is given, and the pamphlet is in every respect full of valuable information for the investor.

AMERICAN TELEPHONE.—It is rumored that there will be a new issue of telephone stock in the spring upon which valuable rights will accure to stockholders. The recent buying of the stock is believed to be based on this fact.

LIGHTING CONSOLIDATION IN NEW JERSEY.—The United Electric Company of New Jersey, with a capital of $20,000,000 has combined all the electric light companies of Hudson and Essex Counties, and several outside these counties. It now controls and operates the properties of 21 once distinct corporations, which have now all been merged into the one organization. These companies are: Jersey City Electric Light Company, Newark Electric Light & Power Company, Central Power Company, Thomson-Houston Electric Company, Newark-Schuyler Electric Company, Essex County Electric Company, Montclair Light & Power Company, Excelsior Electric Company, Kearney Electric Light & Power Company, Hudson County Electric Company, People's Light, Heat & Power Company, Consumers' Electric Light & Power Company, Suburban Electric Light & Power Company, Edison Electric Light & Power Company, Hudson Electric Light Company, North Hudson Light, Heat & Power Company, Suburban Electric Company, Union County Electric Company, Elizabeth-Schuyler Electric Company, Consumers' Light, Heat & Power Company and Morris County Electric Company. The various electric light companies of Hudson County and vicinity were absorbed by the People's Light, Heat & Power Company last March, and the Consumers' Light Company and the other companies which were finally merged into the United Electric recently, had, prior to this action, absorbed smaller companies in their respective vicinities. For some time the United Electric has owned nearly all the capital stock of the People's, North Hudson, Consumers' Light, and Morris County companies. The President of the United Electric Company is A. B. Carlton, Comptroller of Elizabeth, N. J. Louis Lillie, treasurer of the United Gas Improvement Company of Philadelphia is treasurer, and Thomas J. George is secretary.

ERIE TELEGRAPH & TELEPHONE.—At the stockholders' meeting of the Erie Telegraph & Telephone, it was voted to reduce the number of directors from 25 to 15 and adopt by-laws providing that one-third in number of the directors shall be elected annually, and that the term of office of directors after the present year shall be three years, and that the date of the annual meeting of the stockholders be changed from the second Tuesday in June to the Thursday in January next preceding the first day of February in each year. The following board was elected: Nordon Abbott, Walter Abbott, A. B. Chandler, Frank A. Cutting, Philip Dexter, Wm. Endicott, Jr., Frederick A. Farrar, Reginald Foster, Chas. J. Glidden, Francis R. Hart, Wm. J. Latta, Frank M. Riter, James J. Storrow, Chas. S. Tuckerman and Henry R. Wilson.

CHICAGO TELEPHONE.—The directors of the Chicago Telephone Company will issue $1,000,000 worth of new stock in April next. This will make the total outstanding stock $8,000,000. It is likely that another million dollars of stock will be issued in October. The proceeds of the new shares will be devoted to payments for extensions and improvements.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—A special meeting of the New York & New Jersey Telephone Company will be held in Brooklyn, N. Y., March 1, to consider an increase in the company's capital stock from $8,000,000 to $15,000,000, the increase to be used from time to time for new construction.

CHICAGO CITY RAILWAY stockholders have unanimously voted in favor of authorizing the issuance of $5,000,000 new stock. The stock shall go to the stockholders at par. Retiring directors were re-elected. The annual statement shows a considerably smaller percentage earned on the stock, but the surplus decreases only $55,000.

MINNEAPOLIS GENERAL ELECTRIC.—The first mortgage 5 per cent gold bonds of the Minneapolis General Electric Company are now being offered in the New York market. These bonds are dated January, 1899, and run 30 years.

Commercial Intelligence.

THE WEEK IN TRADE.—There was a larger volume of business, on the whole, the relatively best reports coming from the West and South. In the leading Eastern markets, however, the reports were not so favorable, and the aggregate business did not equal expectations. Trade collections, as a whole, are fair, the only complaints coming from sections where the mild weather has interfered with the distribution of heavy goods. In contemplating the general trade situation, *Bradstreet's* says: Measured by the earnings of railroads, the volume of the country's business is certainly in excess of a year ago, while bank clearings, though of course swelled by heavy stock speculation, show immense gains, and, in fact, exceed all records for the first month of the year. Among manufacturing industries rather more irregularity is to be noted. Foundry iron is weaker, while some finished steel products are higher. Woolens are slow of sale, and the squeeze in raw cotton, though temporary, has not helped converters, who have to pay more for their material but get no more for their finished products. Heavy cuts in rubber goods point to coming sharp competition in this industry. Export trade in crude forms of iron is lifeless, but in finished lines a good business is still doing in railway material. Shipments of locomotives to France, steel rails to Mexico and South Africa, and steel billets to England are reported. Favorable crop reports and larger Northwest receipts have slightly weakened the prices of wheat; corn is also slightly lower on heavy increases in the visible supply. The gross earnings of 60 railways for the first three weeks of January show a net gain of 8.7 per cent over the same period last year. *Bradstreet's* reports the number of failures last week as 238, compared with 281 the week previous, 171 the same week last year, 207 in 1899, 285 in 1898, and 305 in 1897. Copper is quiet, and official prices are kept at 17 cents for Lake and 16⅝ cents for electrolytic and casting stock. Large producers are adhering to these quotations, which are nominal, but it is understood that these prices can be shaded considerably.

THE FIRM OF ROSSITER, MACGOVERN & COMPANY has been in existence a matter of some seven years in New York City, during which time it has built up not only an excellent reputation but an immense business. It has gone to the front very rapidly and established a place for itself among the leading business houses in the electrical industry, under the active management of Mr. Frank MacGovern, who is so well known throughout the trade and who devotes his time personally to the purchasing of electrical and steam equipment and disposing of it throughout the country. The firm has recently closed one of the largest deals with the Pan-American Exposition Company that the latter concern has entered into. It has sold to the Buffalo Railway Company the equipment which has been called for on account of the anticipated rush of business during the Exposition, to the extent of 2500-hp generators and the necessary engines to drive them, together with the belts, fittings, etc., the generators including one 500-kw General Electric direct-connected generator, one 400-kw General Electric generator direct-connected to a Hamilton-Corliss engine, two 400-kw belt-driven General Electric generators with one 1100-hp Hamilton-Corliss engine to drive them. It has also sold to the same company boilers to the amount of about 1000 horse-power, and likewise 100 street cars. To the Pan-American Exposition it has sold three 350-hp Armington & Sims engines for driving the Westinghouse Electric & Manufacturing Company dynamos for use in lighting the Exposition. The business of the company is rapidly spreading to embrace a number of other lines, and preliminary arrangements have already been made to open a London office. Mr. MacGovern, in conjunction with some prominent gentlemen from the Argentine Republic (notably Mr. Benigno Ocampo) has recently closed a contract with the Electric Vehicle Company to form a licensee company to operate its vehicles in the Argentine Republic and other sections of South America.

SUBMARINE BOATS.—Work is progressing rapidly on four submarine boats of the Holland type now under construction at Lewis Nixon's Crescent shipyards, at Elizabethport, and the vessels, it is said, will certainly be delivered to the United States Government at the time specified. Mr. Nixon is also building a similar boat for the Holland Torpedo Boat Company, to take the place of the Plunger, and, according to the contract, this boat is to be delivered in eight months. The four boats for the Government are counterparts of the Holland, except that they are slightly larger and certain safety appliances not in the Holland will be introduced. Their increased size will afford more room for the crew and for larger engine power, which will give them a greater steaming radius. In a recent letter to George E. Foss, chairman of the House Committee on Naval Affairs, Mr. Nixon asserts that the performances of the Holland leave no room for discussion as to the efficacy of this type of warship, and writes in part as follows: "From my long experience in designing and constructing war vessels for the Government I have no doubt whatever of the endurance, habitability, durability and reliability of these boats. No type of boat in the navy has received such crucial tests as the Holland. The submarine boat to-day is further advanced in its development than any type of naval vessel that I am aware of. I desire to say that in my opinion, the Holland, without any improvements, is to-day the greatest vessel for harbor and coast defense ever known."

MR. JAMES TATLOW, chief engineer of the mechanical department of the Lancashire & Yorkshire Railway, one of the big North of England roads, accompanied by Chief Civil Engineer Worthington and Goods Traffic Manager Hauxwell, of the same system, are now in this country for the purpose of looking into the question of cost in running the various electric roads in the United States. The directors of the English line are considering the advisability of adapting electric motive power with a view to handling their suburban traffic, particularly between Bolton and Manchester, a distance of 12 miles. The English engineers will inspect the several electric systems in Philadelphia, Baltimore, Pittsburg, Chicago, Milwaukee, St. Paul, Buffalo and Boston, and expect to return to New York about Feb. 20.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended Jan. 23: Antwerp—18 cases electrical material, $2,535. Argentine Republic—64 packages electrical material, $5,410; 5 cases electrical machinery, $344. Barcelona—1 automobile, $800; 10 cases electrical material, $20. Birkenhead—2 cases electrical material, $338. Brazil—150 packages electrical material, $11,843. Bremen—50 cases electrical material, $510; 12 cases electrical machinery, $1,156. British Australia—471 packages electrical material, $40,563; 5 motor vehicles, $2,000; 94 packages electrical machinery, $2,375; 32 reels cable, $13,029. British East Indies—82 packages electrical material, $9,316; 78 cases electrical material, $8,718. Basle—21 boxes electrical material, $1,104. British West Indies—41 cases electrical material, $1,675. Berlin—8 cases electrical material, $748. Chili—32 packages electrical material, $1,200. Cuba—146 packages electrical material, $3,540. Central America—132 packages electrical material, $1,755. Dunkirk—22 cases electrical material, $4,027. Dutch West Indies—22 packages electrical material, $474. Ecuador—211 packages electrical material, $879. Frankfort—1 package electrical material, $70. Glasgow—212 cases electrical material, $4,634. Hamburg—4 packages electrical machinery, $857; 9 packages electrical material, $681. Havre—163 cases electrical material, $24,577; 4 cases electrical machinery, $152. Leeds—26 packages electrical material, $1,502. Liverpool—31 packages electrical machinery, $3,148; 65 packages electrical material, $4,272. London—94 packages electrical machinery, $2,167; 353 packages electrical material, $12,357; 1 reel electric cable, $297. Mexico—198 packages electrical material, $5,596; 15 cases electrical machinery, $1,825. Manchester—138 cases electrical material, $18,323. Peru—131 packages electrical material, $1,282. Preston—107 packages electrical material, $17,400. Riga—5 cases electrical material, $255. San Domingo—19 packages electrical material, $327; 1 case electrical machinery, $74. Southampton—58 packages electrical material, $2,429. U. S. Colombia—33 packages electrical material, $1,241. Uruguay—18 packages electrical material, $500. Venezuela—4 cases electrical material, $113.

RATING OF MACHINERY.—Mr. F. V. Henshaw, under date of Feb. 1, writes to the New York *Sun* as follows: "In the very interesting article from Berlin in to-day's *Sun* in regard to the market in Germany for American manufactures, I notice a statement referring to the practice of American manufacturers of electrical machinery, which is absolutely untrue, and is undoubtedly the result of misinformation on the part of your correspondent. In drawing attention to the importance when competing in a foreign market, of a thorough understanding of the differences in practice and standards which exist in the different countries, an incident in illustration of the result of overlooking such differences in practice is given, wherein a German buyer ordered an American dynamo of a certain horse power, which upon being put in operation was found to be too small for the specified output, and it is explained that the German buyer had not been deceived, because "under American practice electrical machinery is rated as a rule up to its maximum capacity, and not, as in Germany, by its normal daily performance." Now, the facts are, that all reputable American manufacturers of electrical machinery rate their machines at the output they will give continuously, and the standard practice is to specify also that the machines will carry their rated load continuously without rising in temperature more than a specified number of degrees, and in addition to guarantee that they will for short periods carry a certain percentage overload. From the wording of your correspondent's article, I am inclined to think that in the case he cites, the difficulty may have been due to a confusion of volts with horse-power; but his explanation as it stands, is distinctly injurious and unfair to American manufacturers."

SIR WEETMAN D. PEARSON, president of the well-known British contracting firm of S. Pearson & Son, Limited, who last week passed through New York en route to the City of Mexico, stated in the course of an interview that his concern had secured a franchise for the conversion of the existing mule tramways in the city of Vera Cruz into electrical power. It will be recalled that mention was made in these columns at the time the project was first discussed. The present mule track is 15 miles in length. There is also a steam tramway which will be electrically equipped. This road is 5 miles long and runs to one of the principal suburbs of the Mexican port. The power house will consist of two 300-kw generators, two 400-hp engines and the same number of boilers of a like horse-power. On beginning operations, 15 double motor cars will be utilized. It is estimated that nearly a quarter of a million dollars will be expended before the new system is an accomplished fact. Construction on the contemplated road will not begin for about three months, as the streets are now being torn up by drainage work. In the meantime, however, Mr. F. Stuart Williamson, consulting engineer, of 257 Broadway, has been instructed to secure bids for the supply of equipment, etc. Sir Weetman has also decided to change the Terminal Railway Company's road from steam into electric motive power. The road, which was built by the Pearson people, runs from the harbor of Vera Cruz. Its length is about 14 miles. This enterprise will, of course, mean additional purchases of rolling stock and machinery.

PLACER MINE PLANT ON THE KLONDIKE.—It is safe to say that the electric light and power plant at Dawson, on the Klondike River, is the only electric power plant in the world furnishing power for a number of different placer mines over a placer mining district. This plant is the property of J. A. Williams, and is operated by the Dawson Light & Power Company, of which Capt. Donald B. Olson is manager. About 3000 lights are connected in Dawson, while on the small placer mine claims scattered up the creeks along the river there are about 1500 lights and 30 motors driving centrifugal pumps for working placer mines. The power house contains a 200-kw 3-phase General Electric generator, giving 2300 volts, at which pressure the distribution around the town and district is made. Wagner transformers are used and Westinghouse motors. A 300-hp Ideal engine and a 300-hp water-tube boiler, made by the Standard Boiler Manufacturing Company, of Harvey, Ill., complete the equipment. The plant is probably the most northerly electric light and power plant in the world. The Northwest Fixture Company, of Seattle, was contractor for the installation.

A NEW DEPARTURE IN MAGNETIC CONCENTRATION.—Witherbee, Sherman & Company, of Port Henry, N. Y., have decided, says the *Iron Age*, to undertake some very interesting experiments in the concentration of the famous magnetic ores which they mine. It is proposed to handle some of the high grade "Old Bed" ore, which runs about 61 per cent in iron. This ore, as it comes from the mine, contains a considerable quantity of fines which are to be screened from the coarse ore over a grizzley. These fines are to be subjected to crushing, and magnetic separation, the idea being to carry them up in grade and subsequently work up the tailings so as to secure a high phosphorus product suitable for the fertilizer trade. An effort will also be made to separate the zirconium. At the same time the coarse ore is increased in value through the separation from it of the fines, and the concentrates will have an increased value owing to the fact that it is expected that they will run about 68 per cent in metallic iron, and that the phosphorus will be reduced to near the Bessemer limit.

HARBOR SEARCHLIGHTS.—The Fortifications bill, as reported to the House of Representatives at Washington, carries $150,000 for electric searchlights for New York Harbor. Brig.-Gen. John M. Wilson, chief of engineers, proposes to locate the lights at Forts Wadsworth and Newton, Fort Hamilton, Fort Hancock, Norton's Point and Ward Point. Forts Wadsworth and Newton are to have seven battery lights, a detecting light and an extra power light, the system to cost $35,000. Six battery lights are planned for Fort Hamilton, one detecting light and one extra power light, at an expense of $25,000. For Fort Hancock, seven battery lights are planned, one detecting light and one extra power light, at a cost of $25,000. Three battery lights, one detecting light and one extra power light, for $15,000, and planned for Norton's Point, while two battery lights and one detecting light are to be installed at Ward Point for $10,000.

THESE WINDY, DRY WINTER MORNINGS, with their accompanying clouds of street refuse blowing all over one's clothes and penetrating into one's eyes, ears and even lungs, make one long for the days when the horse will disappear from our streets and be replaced by the mechanically propelled vehicle which will not contribute materially to this street refuse for which the horse is so largely responsible.

THE AMERICAN BRIDGE COMPANY has closed a contract with the Crown Agents for the Colonies of Great Britain to furnish and erect on the line of the Uganda Railway, in Africa, 27 viaducts. This will require about 6000 tons of steel work. These viaducts consist of plate girders spanned on towers. The highest tower will be 112 ft. Sir A. M. Rendel & Company, of London, are the engineers for the Crown Agents.

BARBADOS, the British West Indian island, is to have an electric road which will be the first system of its kind in that part of the world. A concession has been obtained by New York parties for the building and operating of the road. It will be an overhead trolley line, 15 miles in length, and will entail an initial expenditure of no less than $1,500,000. The construction of the track will begin inside of two months, when the contracts as to equipment, etc., will be decided upon.

THE SOUTHPORT TRAMWAYS COMPANY, England, which operates the trolley road running in that Lancashire summer resort, is about to be extended. Present advices do not state what the proposed extension will be, but specifications are now being prepared on the other side and will be issued inside of a fortnight.

THE JOHN STEPHENSON CAR COMPANY, of Elizabeth, N. J., has secured an order for eight double-deck trolley cars, which are intended for utilization by the Cheltenham (England) Tramways Company.

W. F. GREENWOOD, general manager and chief engineer of the Havana Electric Company, is at present in New York. He can be found at the offices of his company, 52 Broadway.

General News.

THE TELEPHONE.

NEW LOUISVILLE, ARK.—A franchise has been granted to a new telephone company of this place.

SOUTH BEND, IND.—The City Council has decided to order telephone and telegraph wires under ground.

BOSTON, MASS.—The Puritan Telephone Company has been incorporated here with a capital stock of $300,000.

MINNEAPOLIS, MINN.—The Albert Lea Telephone Company has been incorporated with a capital stock of $15,000.

INDIANAPOLIS, IND.—The Board of Public Safety is advertising for bids to construct the new fire alarm system.

JACKSON, MICH.—The United States Telephone Company has been granted a franchise to build a toll line through this place.

WINCHESTER, TENN.—The Dixie Telephone Company proposes to reduce its rates for telephone service throughout the county.

DOVER, DEL.—The Diamond State Telephone Company has purchased the telephone lines between Hepbron Station, Still Pond and Betteron.

GRANITE CITY, ILL.—The management of the Kinloch Telephone Company has secured all the switchboards and other apparatus for its central office.

ASHLEY, OHIO.—The Ashley Telephone Company has been organized and will install an independent exchange in this place. Capital stock, $5,000.

GREENCASTLE, IND.—Putnam County men have asked the Council for the privilege of erecting poles and wires in this city for a free telephone system.

WINONA, OHIO.—The Winona Central Telephone Company has been organized to install an independent exchange in this place. Capital stock, $10,000.

BALTIMORE, MD.—The Garrett County Telephone Company has begun work on an extension of its line from Eagle's Mills to the Cove, about three miles long.

CLIFTON, OHIO.—The Central Union Telephone Company has secured about 50 subscribers in this vicinity and will open an exchange with toll lines to Springfield.

SAN FRANCISCO, CALIF.—Quite an extensive system of barbed-wire fence telephone lines has been developed by the farmers in the country surrounding Stockton, Calif.

ALBANY, N. Y.—The New Berlin Telephone Company of New Berlin has been incorporated; capital, $3,000. Directors: I. L. Richer, E. G. White and A. H. Phelps, New Berlin.

TOLEDO, OHIO.—The Lucas County Commissioners are considering the advisability of securing a lighting plant for the court house, jail and grounds. Estimates are being prepared.

LOGANSPORT, IND.—The Central Union Telephone Company is soliciting among the farmers of this county, with a view of extending its service through the prosperous rural districts.

KEITHSBURG, ILL.—The Tom A. Marshall Telephone Company of Keithsburg has been incorporated; capital, $50,000. Incorporators: Tom A. Marshall, Frederick P. Burgett and David Adelsdorf.

GREAT BARRINGTON, MASS.—A fire on Jan. 29 destroyed the principal business block in this city. It included the telegraph and telephone offices, and all communication by these means was entirely cut off.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is installing a number of toll stations in all parts of the city and vicinity. Toll boxes manufactured by the American Toll Telephone Company, Cleveland, are used.

WAUSEON, OHIO.—At a meeting on Feb. 8 the Northwestern Ohio Telephone Company's stockholders will vote on a proposition to increase the capital stock of the company to $40,000. A number of improvements have been proposed.

TWO RIVERS, WIS.—The first fence-wire telephone line to be placed in operation in this section is being built from Sandy Bay to Kewaunee, a distance of eight miles. Connections will be made at Kewaunee with the Wisconsin Telephone system.

LA GRANGE, IND.—The Northern Indiana & Southern Michigan Telephone Company has been organized in this city with a capital stock of $50,000. It has purchased the local plant of the Johnston Bros. and will make all the circuits metallic. The local plant has 700 subscribers.

HAMILTON, OHIO.—The Lawton-Beattie Company of Cincinnati has just completed the installation of a complete telephone plant in the establishment of the Niles Tool Works Company. The instruments were furnished by the Simplex Interior Telephone Company of Cincinnati.

ASHLAND, OHIO.—The Star Telephone Company has elected the following officers: G. A. Ullman, president; S. H. Grabill, vice-president; E. J. Grosscup, treasurer; Howard Schwartz, secretary and superintendent. Directors are the above, with J. R. Schwartz, T. G. Stence, J. N. Brown and W. P. Ullman.

CLEVELAND, OHIO.—The United States Telephone Company's long-distance line from Toledo to Adrian, Jackson, Lansing, Owasso and Saginaw, Mich., will be completed within the next 60 days, when nearly all the independent exchanges in the Michigan association will be given long-distance connection.

ELKHART, IND.—At the annual meeting of the Home Telephone Company of Elkhart County the following officers were elected: President, C. W. Miller; vice-president, I. O. Wood, both of Goshen; H. B. Sikes and G. H. Fister, both of Elkhart, treasurer and secretary, respectively. A full board of directors was also elected.

MEMPHIS, TENN.—The Memphis Telephone Company has been chartered with a capital stock of $2,000,000. The incorporators are William P. Curtis, S. P. Walmsey, William P. Richardson, C. B. Galloway, Jeptha M. Fowlkes, Bolton Smith, Thomas R. Reddick, Leon Hunt, James S. Warren and William A. Percy. The company obtained a franchise about two years ago.

CORYDON, IND.—The plans which have been quietly taking shape between Louisville and Cleveland parties for a telephone service for this (Harrison) county have, it is said, been consummated. This service will have long distance connections through the Kinloch Company, of St. Louis, the new Indianapolis company and the United States Company at Cleveland.

ST. LOUIS, MO.—The annual meeting of the Kinloch Telephone Company was held Jan. 28. The books showed that a successful business had been done. The company has raised its rates on residence telephones to $48 per year, unlimited service. There are now 6500 telephones installed and others have been ordered but cannot be supplied until the pole and cable capacity has been increased

SALEM, OHIO.—The Columbiana County Telephone Company has completed traffic arrangements for interchange of service with the Phoenix Telephone Company, operating exchanges in Steubenville, New Cumberland, Mingoe, Toronto, Wellsburg and other points in that vicinity. The Phœnix Telephone Company will also have long distance service through the lines of the United States Telephone Company.

WARREN, OHIO.—The directors of the Warren & Niles Telephone Company have elected the following officers: Washington Hyde, president; Jules Vautrout, Jr., vice-president; J. J. McClean, secretary and treasurer; E. G. Miller, general manager. The company is putting up 3000 ft. of cable in Warren and 2000 ft. at Niles; eventually the entire system in both places will be cabled. A 200-drop section of switchboard is being prepared for use at Warren.

DALLAS, TEX.—Conferences between organized labor bodies and the Board of Aldermen are being held, with a view to having granted to a company composed of laboring men a franchise for an independent telephone system in Dallas. The labor organizations of Texas are supporting a strike of union electrical workers in the State against the Southwestern Telephone Company, and this movement for a rival organization is enlisting keen general interest.

ST. LOUIS, MO.—A bill has been introduced in the Missouri Legislature providing that the following rates shall be charged in transmitting messages over telephone wires and for the use of telephone receivers and transmitters: For 24 words or less a distance of 100 miles or less, 10 cents; for every 24 words or more 100 miles or more, 1 cent for each word or figure; for the use of telephone receivers and transmitters, not to exceed 75 cents per message. Violations of the law are made punishable by a fine of not less than $25 nor more than $200 for each offense.

KOKOMO, IND.—Competition has stimulated the telephone business in this city. Last September, before the new company started business, only 225 telephones were in use; but after a three-months' fight between the competing companies, there are 1300 instruments in use. The war is still on, and the struggle is extending into the country and near-by villages. The Bell Company has cut the resident rate to fifty cents per month, but the new company successfully maintains its original rate of $1.25 for residents and $2 for business houses. The new system has 850 subscribers and the old one 450.

TELEPHONE RENTALS.—The Indiana Appellate Court decided the appeal of the Rushville Co-Operative Telephone Company against Irwin adversely to the latter. Irwin claimed the company owed him some money and refused to pay the company's bill for service until it should settle with him. The company therefore cut off his service. The Court held that Irwin had no right to set off a debt against his telephone bill; that a telephone company cannot be required to stop and adjudicate claims against it when collecting rental, and that the company was justifiable in cutting off the service and liable to no penalties.

BOSTON, MASS.—The American Telephone instrument statement for the month ended Jan. 20 shows:

	1901.	1900.	1899.	1898.
Gross output	66,048	58,853	46,548	25,861
Returned	25,766	18,966	14,719	10,041
Net output	40,282	39,887	31,829	15,820
Total outstanding	1,993,098	1,620,392	1,157,075	938,073

ELECTRIC LIGHT AND POWER.

HAGERSTOWN, IND.—This town will at once begin the construction of a $14,000 municipal electric lighting plant.

CAMBRIDGE, OHIO.—The City Council of Cambridge has just renewed the contract for lighting the streets for ten years at $70 per light.

RICHMOND, IND.—The City Council and Mayor closed the contract with the Varney Construction Company for a new municipal lighting plant.

DEFIANCE, OHIO.—The General Electric Company has just completed the electric equipment in the works of the Defiance Milling Machine Company.

HARTFORD, CONN.—The directors of the Hartford Electric Light Company have declared a semi-annual dividend of 3½ per cent., payable Feb. 15.

JACKSON, TENN.—The City of Jackson has decided to install an electric light plant of its own. The Council has everything in readiness to advertise for bids.

KEWANEE, ILL.—The Kewanee Light & Power Company has announced that hereafter it will pay all employees the same per cent on their salaries as given to shareholders as dividends.

MIDDLETOWN, OHIO.—The installation of a complete electric plant has just been finished in the new works of the American Rolling Mill Company. Officials expect to be turning out sheet steel by the middle of February.

SPENCERVILLE, OHIO.—The new electric light service, consisting of 36 arcs and a commercial circuit has just been completed under the supervision of the Lawton-Beattie Company of Cincinnati. The Fort Wayne Electric Company furnished the machines.

BINGHAMTON, N. Y.—The Norwich Electric Company has purchased the electric light plant in Norwich and will furnish the village with light in the future. The company, which has a capital stock of $1,000,000, will also furnish gas for fuel and domestic purposes.

CONNECTICUT.—The United Gas Improvement Company proposes to operate the several plants of the Connecticut Railway & Lighting Company by power generated on the Housatonic River and transmitted at high voltage to various stations in the system. The company owns the entire stock of the Housatonic Power Company.

ST. LOUIS, MO.—At the annual meeting of the St. Louis Electrical Exchange recently the following officers were elected: E. T. Cook, president; F. B. Adams, vice-president; Wm. Wurdack, secretary; F. E. Newberry, treasurer; C. J. Luther, sergeant-at-arms. Board of Directors—Wm. Corrao, C. F. Smith, A. C. Wolfram, A. Boes Chen Stein, F. E. Briner and F. B. Adams.

CINCINNATI, OHIO.—The Cincinnati Edison Electric Company is erecting two E. P. Allis cross-compound condensing engines of 2000 horse-power each. The engines are direct connected to a 1000-kw three-phase alternator, a 900-kw 150-volt direct-current generator and a 1000-kw 300-volt direct-current generator. The company is also erecting six Babcock & Wilcox boilers of 800-hp rated capacity each.

ATLANTA, GA.—It is stated that strong pressure is being brought to bear on the Electric Lights Committee of this city to report favorably on the petition of the Atlanta Railway & Power Compay for an electric lighting franchise. A petition has been sent to the committee, alleging that the Georgia Electric Light Company is endeavoring to force consumers to sign long-term contracts or bear heavy expenses for new wiring, motors and service connection.

PANA, ILL.—The Pana Electric Light Company has brought suit against Robert Johns, former owner of the plant, for $50,000 for alleged obstruction of business. Johns sold the plant to the present owners a year ago, taking in part payment 25,000 acres of land in Virginia. The land, he alleges, proves to be rocky and worthless. A few days ago when the company endeavored to move a dynamo Johns had issued an attachment preventing the removal, hence the suit.

CLEVELAND, OHIO.—George S. Rider, a well-known electrical engineer, is preparing plans for a power house for the W. S. Tyler Wire Works, Cleveland. Engines and boilers of about 500-hp capacity each and a generator of about 250-kw capacity will be required. Mr. Rider is also designing an addition to the power plant of the Cleveland Twist Drill Company and has placed contracts for a 400-hp Ball & Wood engine, 400-hp Babcock & Wilcox water-tube boilers with automatic stokers, and a 250-kw two-phase Westinghouse generator.

SOUTH MILWAUKEE, WIS.—The Common Council has passed the 50-year street car franchise asked for by the Milwaukee Light, Heat & Traction Company, which carries with it a contract to light the streets of the city for a period of 10 years at $80 a lamp-year for light up to 1 o'clock, and $90 a lamp-year for light all night. The lighting business was formerly done by the South Milwaukee Light & Power Company, but the city has had no lights for several months. The city offered to buy the plant, but the Mayor would not place his signature and this caused the shutting down of the plant and the Mayor to be deposed from office. Now the whole matter has been cleared up by the new franchise.

THE ELECTRIC RAILWAY.

QUEBEC, QUE.—The Levis Electric Railway Company of Levis, Que., is seeking incorporation.

BUCYRUS, OHIO.—Cleveland promoters are securing right of way for a line from Bucyrus to Shelby.

ELKHART LAKE, WIS.—An interurban electric road between this city and Sheboygan is talked of. M. M. Gottfried, of this place, is interested.

DELAWARE, OHIO.—The Union Electric Railway Company, with a capital stock of $300,000, has been incorporated in New Jersey by Eastern capitalists.

CLEVELAND, OHIO.—The promoters of the Cleveland, Ashland & Mansfield Railway Company, recently organized, have decided on the route for the road.

CLEVELAND OHIO.—At the annual meeting of the stockholders of the Cleveland Electric Railway Company the old directors and officers were re-elected.

EAST LIVERPOOL, OHIO.—Residents of Hookstown have offered a bonus to the East Liverpool & Rock Springs Railway Company to extend its line to Hookstown.

TOLEDO, OHIO.—The Toledo, Bowling Green & Fremont Railway Company is securing right of way with a view of extending its line from the present terminus at Jerry City to Fostoria.

CLEVELAND, OHIO.—At the recent annual meeting of the stockholders of the Cleveland, Painesville & Eastern Railway Company the present directors and officers were re-elected.

BLANCHESTER, OHIO.—The Clinton County Commissioners and the Blanchester Council have granted twenty-five-year franchises to the Cincinnati, Dayton & Maysville Railway Company.

TOLEDO, OHIO.—The Toledo, Napoleon & Defiance Railroad Company has been incorporated by Charles E. Sutton, Richard Hattersley, H. C. Webster and John F. Kumler. Capital stock, $25,000.

DAYTON, OHIO.—The directors of the Dayton, Springfield & Urbana Railway Company have decided to build a branch line from Osborn to Xenia by the way of Fairfield, Byron and Yellow Springs.

BELOIT, WIS.—Two applications were made for electric railway franchises by the Rock River Electric Railway through its president, J. F. Barber, of Eau Claire, and by H. H. Clough, of Elyria, Ohio.

AKRON, OHIO.—The Northern Ohio Traction Company is securing right of way between Kent and Ravenna with a view to extending the recently acquired Rapid Transit Company's line to Kent, on to Ravenna.

CINCINNATI, OHIO.—The Hamilton, Glendale & Cincinnati Traction Company has been incorporated by W. P. McCarty, Wm. S. Mundsell, George Kelly, Claude Ashbrook and Fred Munderhelman. Capital stock, $250,000.

TOLEDO, OHIO.—The Toledo, Waterville & Southern Railway Company has been incorporated by Harry E. King, Thomas H. Tracey, Harry W. Lloyd, Frank W. Coughling and James R. Murphy. Capital stock, $25,000.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has offered Milwaukee County $40,000 for property adjoining its power house. This property is needed for the new power house to be built this year.

TOLEDO, OHIO.—The stockholders of the Toledo, Bowling Green & Fremont Electric Railway have elected the following directors: L. Black, J. A. Hutson, M. I. Wilcox, C. S. Schenck, George Breymann, R. Hamlin.

EAST LIVERPOOL, OHIO.—The East Liverpool Street Railway Company is preparing to make some extensive improvements on its system. The Wellsville line will be double tracked and improved. About $75,000 will be spent in improvements.

ELKHART LAKE, WIS.—Application has been made to the village board by J. M. Seaman, of Sheboygan, and P. P. Brickbauer for a seventy-five-year franchise to build and operate a street car line in this village, connecting with the Sheboygan interurban line.

YOUNGSTOWN, OHIO.—The promoters of the Youngstown & Sharon Railway Company have applied for a charter in Pennsylvania for a company to be known as the New Castle & Sharon Electric Railway Company, which means the extension of the road to New Castle.

CLEVELAND, OHIO.—The Cleveland & Eastern Railway Company has elected officers as follows: H. P. McIntosh, president; H. A. Sherwin, vice-president; E. G. Tillotson, secretary-treasurer. Directors: E. G. Tillotson, H. Clark Ford, W. H. Lamprecht, R. A. Harman, H. A. Sherwin, Howard White, W. N. Gates and H. P. McIntosh.

STEUBENVILLE, OHIO.—The Steubenville Traction & Light Company has been incorporated by Justin A. Moore, J. S. Paisley, J. M. Powers, C. P. McFadden and B. J. C. Armstrong. Capital stock, $50,000. The company will build an electric railway from Steubenville to Toronto and will furnish light in both places; also in intermediate towns.

MILWAUKEE, WIS.—The annual report of the Milwaukee Electric Railway & Light Company and the Milwaukee Heat, Light & Traction Company shows dividends paid on the capital stock of the street railway company of $224,586, and on the traction company of $8,701.40. It also shows the total number of miles of track of the street railway company to be 175.99.

CLEVELAND, OHIO.—At the meeting of the stockholders of the Cleveland City Railway Company, held a few days ago, the old directors and officers were re-elected. The net receipts for the year were nearly $1,500,000, an increase of $28,000 over last year. The proposition to increase the capital stock from $8,000,000 to $9,000,000 was not discussed and will not be brought up again for some time.

TROY, OHIO.—The Miami Valley Railway Company, which operates a road from this place to Piqua, has secured right of way for the extension of the road to Minister, to connect there with the Western Ohio Electric Railway Company's road now being built from Lima. With the completion of these and other roads now building there will be a complete electric line from Cincinnati to Toledo.

LIVERPOOL.—The proposed electric express railway between Manchester and Liverpool appears to be in a fair way to be realized. It will be recalled that a scheme was defeated at the last session of Parliament, but the plans have been so altered as to meet the principal objections against the previous bill, and now have the approval of practically all of the local authorities of the places through which the proposed line will pass.

CLEVELAND, OHIO.—The Cleveland, Medina & Southern Electric Railway Company and the Cleveland, Elyria & Western Railway Company, rivals for a road from Cleveland to Medina and Wooster, have combined interests and have organized a new company, known as the Cleveland & Southern. The temporary capital stock is $10,000, which will be increased later to $1,000,000. Incorporators: A. H. Pomeroy, W. H. Lamprecht, A. E. Akins and U. G. Walker.

COLUMBUS, OHIO.—Levi D. York, of Portsmouth, who has been promoting a road from Columbus to Portsmouth, has joined forces with the Columbus & Southern Railway Company, which proposes to build over a portion of the same route. The company has reorganized, with the following officers: J. M. Wilson, president; Z. F. Downs, vice-president; W. E. Hoffman, treasurer; Smiley Caldwell, secretary. The capital stock has been increased to $1,000,000.

CIRCLEVILLE, OHIO.—In order to decide between rival lines the City Council advertised for propositions for a franchise through this place. The Scioto Valley Traction Company offered the following rates of fare: Cash fare, 5 cents; 6 tickets, 25 cents; 13 tickets, 50 cents; 27 tickets, $1. The company gave a certified check of $1,000 and offered a bond of $5,000. The Columbus & Southern Railway Company offered to carry passengers free of charge inside the city limits and to pay $100 per year for each car operated. President Wilson of the latter company stated that the through traffic between Chillicothe and Columbus would make this rather surprising proposition a profitable one. The matter is under consideration.

MILWAUKEE, WIS.—An electric railway to be built from this city to Lake Geneva is being promoted by some Eastern capitalists. It is proposed to run the line through the counties of Waukesha and Walworth, touching Beloit and several smaller towns. There is also a possibility of branches running to towns not too far from the main line. In Milwaukee the road would be elevated, but outside of the city it would be on the surface, the third rail system being employed throughout. It is estimated that outside of Milwaukee it will cost to build the road between $15,000 and $20,000 a mile, and that the completion of the enterprise will represent an expenditure of between $4,000,000 and $5,000,000. The distance between Lake Geneva and Milwaukee, as the road will run, is about 60 miles. The business of the road will be both freight and passenger.

YOUNGSTOWN, OHIO.—At the annual meeting of the Mahoning Valley Railway Company, held a few days ago, it was decided to practically rebuild the entire system. This will include tracks, rolling stock and power house, and the expenditure will be close to $1,000,000. Officers and directors for the following

roads controlled by the Mahoning Valley Company were chosen: Mahoning Valley Street Railway Company, Struthers & State Line Railway Company, Mahoning Valley Southeastern Railway Company, Trumbull Electric Railway Company, Mineral Ridge & Niles Traction Company. A. A. Anderson is treasurer and general manager of the entire system. The officers include James Parmelee, Myron T. Herrick, Harry Dixon, B. F. Miles, J. W. Crawford of Cleveland, and A. L. Rowland, M. A. Verner, J. G. Butler and C. F. Clapp of Youngstown.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL ENGINEERING & DEVELOPING COMPANY, of New York City, has been organized; capital, $10,000. Directors: H. S. Cooper, Ithaca; W. S. Gurnsey, 3d, New York City; B. Y. Frost, Nyack.

THE H. KRANTZ MANUFACTURING COMPANY, of Brooklyn, has been incorporated, to deal in switchboards and electrical appliances; capital, $150,000. Directors: H. Krantz, A. N. Nielsen and W. M. Moore, Brooklyn.

LEGAL.

TELEPHONE DAMAGE CASE.—Last April Rev. O. B. Wilson, of Tuscaloosa, Ala., was struck by lightning and killed while he had a telephone to his ear. Suit was brought against the Southern Bell Telephone & Telegraph Company for $25,000, but the case was recently settled by the executors accepting $1,800 from the company.

CLAIMS AIR ABOVE HIS LAND.—Rufus W. Smith of Elmer, N. J., in a bill filed in the New Jersey Chancery Court, seeks to enjoin the Delaware & Atlantic Telephone Company from running wires across his land. The poles supporting the wires are not on his ground, but are on adjacent land, where they were placed with the consent of the land owners. Mr. Smith's contention is that he owns the air as high as he chooses to go, and that the exercise of the right by any one else without his consent is a trespass.

OBITUARY.

MR. JOSEPH GILLET NOYES, secretary and general manager of the National Electrical Manufacturing Company, of Milford, Conn., died at his home in that village on Jan. 15 after an illness of only a week, death being due to a complication of pneumonia and Bright's disease, with the throat trouble which first attacked him. Mr. Noyes was only 40 years of age and had been active in the management of this company since its organization in 1890. He had a large circle of business acquaintances in this city and throughout the East.

PERSONAL.

MR. JOSEPH BATTLES, president of the Lawrence Machine Company, Lawrence, Mass., was a visitor to New York last week.

MR. C. J. TOERRING, of Philadelphia, maker of the Toerring 250-hour enclosed arc lamp, was a visitor to New York the early part of this week.

MR. L. ROBINSON, who has been manager of the Montreal Park & Island Railway for the past four years, has retired to accept a post with the Compagnie de Traction of Paris, France.

MR. CHAS. A. MOORE, of Manning, Maxwell & Moore, who was lately made a member of the French Legion of Honor, has just been elected president of the American Tariff League.

MR. J. H. VAIL, the electrical engineer, has removed his office in Philadelphia from 1107 Walnut Street to 715-18 Hale Building, 1328 Chestnut Street. He has been engaged lately on several important installations.

MR. W. S. BROWN has resigned his position with the Sprague Electric Company and taken the management of the Eastern sales department of the Richmondt Electric Wire Conduit Company, with New York headquarters at 39-41 Cortlandt Street.

COL. J. W. RUTHERFORD and Mr. H. A. Douglas were in general charge of the erection of the independent telephone exchange at Atlanta, Ga., recently described in these pages. They represented the Atlanta Telephone Construction Company, of which Mr. Otto C. Wolf is treasurer and manager.

MR. E. D. LATTA, president and treasurer of the Charlotte (N. C.) Electric Railway, Light & Power Company, was in New York City last week. Legislation is being attempted in the genial State of North Carolina to force vestibules on the street cars, and Mr. Latta could not help noticing that even here in New York the motormen get along without them.

MR. THOS. H. McLEAN, the well-known vice-president and general manager of the Toledo Traction Company, informs us that there is nothing in the rumor that he is to go to Chicago to take hold of one of the big systems there. He is back in harness again at Toledo, after his indisposition, and finds himself very much benefited in health by his vacation.

MR. THOMAS DIXON, who has been associated with Manager T. J. Ryan of the Fort Wayne Electric Works' Cincinnati office for a year or more, has taken charge of the company's St. Louis office and in future will direct the work of that territory. Mr. Dixon, prior to his connection with the Fort Wayne company, represented the General Electric Company, traveling through Ohio for six years.

MR. W. T. GENTRY.—At a meeting of directors of the Southern Bell Telephone & Telegraph Company, W. T. Gentry of Atlanta, Ga., was appointed general manager of that company, with headquarters at Atlanta. Mr. Gentry succeeds Charles H. Wilson, who resigns to accept the position of general superintendent of the American Telephone & Telegraph Company, with headquarters at New York.

MR. T. F. RYAN, of this city, who for 15 years has been William C. Whitney's closest business associate and personal friend, has bought the Oak Ridge estate on the Southern Railway, in Nelson County, Virginia, just north of Charlottesville. He has also purchased 4000 acres additional adjoining this property. Mr. Ryan was born in Nelson County, within a few miles of Oak Ridge, which is one of the finest of the old estates of Virginia.

MR. H. G. CARLETON, the well-known dramatist and inventor, president of the Carleton Electric Company, has had a stroke of apoplexy due to overwork, but is now recovering. He was to have attended the recent dinner of the American Institute of Electrical Engineers, but was taken with grip, the graver symptoms supervening. He is now on the road to recovery and the doctors assure complete restoration, news which his many friends hear with great pleasure.

HON. C. STANHOPE, who acts as chief adviser to the well-known London financial house of Wernher, Beit & Company in relation to its electrical enterprises in Mexico and South Africa, has just arrived from Europe en route to the City of Mexico. Mr. Stanhope, who has been stopping at the Albemarle Hotel, Broadway and Twenty-fourth Street, is president of the City of Mexico Tramways Company, which concern operates the first electric road that was established in that part of the globe.

MR. R. H. KLAUDER.—The Electric Storage Battery Company of Philadelphia, manufacturer of the "Chloride Accumulator," announces that owing to the very large increase in its business in the middle Western States, it has established a branch office at St. Louis, Mo. This office has been placed in charge of Mr. R. H. Klauder, formerly of the Philadelphia staff, and will be located in the Wainwright Building. Mr. Klauder's extensive experience, gained during his connection with the electric storage battery, has made him thoroughly familiar with up-to-date practice.

MR. A. WILFORD ZAHM, secretary and general manager of the Manhattan Light, Heat & Power Company, and manager of the Manhattan Building, St. Paul, has resigned his position to accept a position as general manager of the Light, Heat, Transit & Public Service Company at St. Cloud, Minn. This company is a new organization, being a consolidation of the Benton Power & Traction Company and the Hertig Light & Heat Company, and it operates the St. Cloud & Sauk Rapids Street Railway Company, in addition to which it is operating an underground steam heating system and electric lighting plant for furnishing light in both St. Cloud and Sauk Rapids.

Trade Notes.

THE EASTERN ELECTRIC COMPANY, Middleton, Mass., has moved its business to Lynn, Mass. The company manufacturers incandescent lamps and expects to double its output in the Lynn plant.

OIL FILTERS IN GUATEMALA.—The Burt Manufacturing Company, Akron, Ohio, has just equipped a large electric light plant at Huehuetenango, Guatemala, Central America, with Cross oil filters.

THE NORTH ELECTRIC COMPANY, of Cleveland, Ohio, has opened an office for its telephone trade in the West, at 1511 Monadnock Block, Chicago. Mr. George W. Conover is in charge of this new department.

THE ELECTRIC APPLIANCE COMPANY is out with a new hotel telephone which it claims has many points of advantage. It is sending descriptions of this instrument to dealers and contractors throughout the country.

ELLWOOD-IVINS MILLS, at Oak Lane Station, Philadelphia, Pa., make a specialty of fine tubing for electrical purposes. They make seamless tubes in steel, copper, aluminum, etc. They make, it is claimed, 90 per cent of all the pointer tubes for voltmeters in aluminum tubes of small diameters and very thin walls.

THE TABER PUMP COMPANY, Buffalo, N. Y., is distributing a very useful and practical addition to one's desk, and one which will be much appreciated. It is a four-year dater and is at one and the same time a date-making and time-saving device. On the top of the handle the user is informed as to the kinds of pumps the Taber Company makes.

DISSOLUTION OF PARTNERSHIP.—The partnership known as the Palmer Electrical Instrument Company, 51 North Tenth Street, Philadelphia, Pa., was dissolved on Dec. 31 last by mutual consent. The former partners in the business were C. W. Swoope, S. M. Palmer and A. P. Palmer. The business will be continued and extended by Mr. C. W. Swoope individually under the old name.

PLATINUM.—As a result of a brief interview with Mr. C. O. Baker, of Baker & Company, relative to the situation of the platinum market, we learn that platinum has never been so high as at the present time, this notwithstanding the fact that the demand has never been greater. All indications, as a result of this condition, point to an early and substantial increase in the present quotations.

H. J. LINDER & COMPANY.—The co-partnership doing business under the firm name of H. J. Linder & Company, at 123 Liberty Street, New York, was, on Jan. 31, dissolved by mutual consent. The firm consisted of James W. Sturges and Herbert J. Linder. Mr. Sturges will continue the business of supplying complete power and electrical appliances under the name of James W. Sturges, at the old address.

THE MACKAY ENGINEERING COMPANY has opened offices in the Singer Building, 149 Broadway, New York, as manufacturers' agent for the Reilly patent pump. This pump is made for low and high pressure, circulating, distributing and condensing, air compression, etc. Aside from the usual types, special pumps are made for acid works, sugar refineries, refrigerating machines, mining, hydraulic elevators, etc.

STEAM TURBINES.—The Westinghouse Electric & Manufacturing Company has just published a pamphlet giving a reprint of the paper read by Mr. Francis Hodgkinson on "Steam Turbines" before the Engineers' Society of Western Pennsylvania last November. This paper was published in three parts in the ELECTRICAL WORLD AND ENGINEER, Dec. 22, Dec. 29 and Jan. 5 last. The pamphlet contains many illustrations, diagrams and curves.

GOOD GREEN GOODS.—Smith & Hemenway Company, of 296 Broadway, the well-known cutlery and hardware specialty house, has just issued a very

neat little "Green Book" of hardware specialties in the size of a pocket edition. With it goes a "Green Book" pocket diary and reminder that everybody will find useful. The firm says: "If you accuse us of having a slight streak of good old Irish blood in our veins we shall not feel the least bit incommoded."

SERIES-PARALLEL SYSTEM OF CONTROL.—The C & C Electric Company of New York, in Bulletin No. 138, very completely describes and illustrates its series-parallel system of control for electric motors. The bulletin contains a reprint of the article in the issue of ELECTRICAL WORLD AND ENGINEER of Jan. 5 last, on this system as applied to the presses of the Philadelphia *Evening Telegraph*. It contains several excellent illustrations of the apparatus used in this system.

CIRCUIT BREAKERS.—The property of certain oils to destroy alternating arcs, or rather to prevent their formation, has led to the development of switching apparatus of the oil type. Messrs. S. B. Condit, Jr., & Company, 63 Oliver Street, Boston, Mass., are manufacturing a line of high and low tension circuit breakers and switches of this class, which instruments are described and illustrated in a neat catalogue just issued by the firm. The firm gives special attention to designing and building high tension switchboards.

SERIES ALTERNATING SYSTEM.—The General Electric Company's series alternating system in practical operation is the subject of a sixteen-page pamphlet of recent issue. This system provides for street lighting by means of alternating current generators, automatically regulating transformers, and inclosed arc lamps connected in series. The pamphlet contains extracts from letters received from central station managers using this system. These letters indicate that in practical operation the system is thoroughly satisfactory.

THE GREGORY ELECTRIC COMPANY, of Chicago, has secured an enviable reputation through the thorough and systematic manner in which it overhauls all second-hand apparatus, a machine after having gone through its regular process being practically equal to new. This company makes a specialty of this business is thoroughly equipped for this kind of work, employing a large number of men who are experts in their several departments. Its repair department has assumed large proportions, the product being shipped to every State in the Union.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, reports an unusual amount of business in small machines, both generators and motors, particularly in domestic orders. A recent sale was of a 100-kw direct current generator for the Garretson Hotel, Sioux City, Ia. Another is for an 80-kw belt-driven machine for the Murray Milling Company, Murray, Ky., and another for two 50-hp motors for the Eagle White Lead Company of Cincinnati. The Triumph Company has just shipped a 200-kw generator to W. F. Grower of Chicago, to be used in a large office building.

HUBBARD, HALL & COMPANY, 213 West Fourth Street, Cincinnati, Ohio, have been in business just one year. The company is a dealer in electrical and kindred supplies of all kinds, making a specialty of supplying everything in the electrical line. Its first year's business has far exceeded its expectations when it started, and it is now well established and pushing to the front. Manufacturers and dealers who have new electrical devices to place on the market would find it to their advantage to correspond with this firm, as it is energetic and active and will push a new device with vim and to probable success.

ART AND PHILOSOPHY IN A CALENDAR.—Messrs. N. W. Ayer & Son, Philadelphia, show much taste and originality in the design of their 1901 calendar. It is mounted on a striking design in clay modeling, executed in two delicate tones, with the firm's motto standing out in relief. The figures are large enough to be easily distinguishable at quite a distance, while the spaces are occupied by reproductions in colors of a number of striking modern posters and by advertising philosophy as well. The cost of the production and the demand for this calendar are so great that the firm has found it necessary to charge a nominal price for it.

THE ELECTRICAL POWER STORAGE COMPANY of London, England, is distributing a handsome desk pad blotter, which is highly appreciated by the recipients. Across the top are twelve strips forming calendars for the year, one of which is removed each month, leaving the calendar for the current month exposed to view. At the left-hand side is a diary for the entire year, with blotting paper interleaved between the pages; discount tables, foreign moneys and their English equivalents, etc., are also given. A novel feature in the calendar is that the cover of the diary is an accident insurance policy, which has to be signed by the recipient, and is then good for $2,500 in case of death by railway accident, with graduated amounts for minor catastrophes.

"STANDARD WIRING" HAND-BOOK.—The 1901 edition of the handbook, "Standard Wiring" for electric light and power, by H. C. Cushing, Jr., of New York, is now ready for delivery. This valuable little book has been entirely revised to date, and has been greatly added to in the way of new and useful tables, formulæ and data. The "general wiring formulæ" on pages 101 to 115, for all systems of wiring, is one of the most complete and valuable additions, and will be of inestimable value to central station men, engineers and firemen. All wiring and constructing done in accordance with the suggestions contained in this book will be passed by fire underwriters' inspectors throughout the United States. This work has been adopted by the Fire Underwriters of the United States.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has sold to the Rupert Brewing Company of New York City two 60-kw engine type generators with switchboard and all auxiliary apparatus, costing approximately $16,000. It has also sold to the Government, for dry dock No. 3 at the Brooklyn Navy Yard, three 450-hp and two 120-hp motors to be used in connection with a pumping outfit. This contract includes complete switchboard and apparatus. The Bullock Company has also placed an additional order from the Prudential Life Insurance Company, of Newark, N. J., for 20 motors to be used in running printing presses. It has also sold to a prominent concern in Tasmania two 250-kw generators and several motors, including one of 90 horsepower, as part of a large power installation.

GLAZE FILLED INSULATORS.—Mr. J. S. Sapp, of the firm of Fred M. Locke, Victor, N. Y., favors us with the following: "My attention has been called to an article in your issue of Dec. 29, 1900, entitled, 'Glaze Filled Porcelain Insulators.' In view of the fact that some of your subscribers who are not familiar with the status of the case therein mentioned may be misled thereby, I beg leave to call attention to the fact that the decision cited in no way affects the insulators made by us. The patent mentioned as granted to Boch being a process patent, only relating to one method of glazing insulators made entirely of porcelain. The litigation in no way affected the Locke patent of Dec. 15, 1896, covering high voltage insulators, claim three of which reads as follows: 'An insulator comprising two members respectively composed of insulating materials having different degrees of puncturability and having various degrees of surface resistance connected together and adapted to be supported substantially as shown and described as a means for insulating currents of very high voltage.'"

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 29, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

666,655. ELECTRIC MOTOR CONTROLLER FRAME AND METHOD OF CONSTRUCTING SAME; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. The invention is directed to the construction of control frames so that when the several parts thereof are made in quantities and assembled they will occupy a definite relation to each other, thus decreasing the cost of manufacture.

666,656. MOUNTING FOR ELECTRIC MOTORS; T. W. Eaton, Chicago, Ill. App. filed Oct. 8, 1900. The exterior cylindrical surface of the motor is adapted to fit into a supporting ring which is concentric with the armature shaft.

666,675. TELEPHONE; G. L. Hogan, New York. App. filed March 9, 1900. (See Current New and Notes.)

666,677. MICROPHONE; A. G. Holcombe, Southampton, Mass. App. filed May 16, 1900. (See Current News and Notes.)

666,691. ELECTRIC MOTOR; O. H. Pieper and A. F. Pieper, Rochester, N. Y. App. filed Feb. 2, 1900. A motor especially adapted for dental and similar purposes and to be suspended over the place of use, and having a universal movement permitting the operator to work in the most convenient manner.

666,698. TELEPHONE-EXCHANGE CIRCUIT AND SIGNALING APPARATUS; M. C. Rorty, Dedham, Mass. App. filed Oct. 4, 1900. Concerns the signaling appliance and operations employed in connections made by means of trunk conductors between sub-station circuits normally connecting with different central stations.

666,699. ELECTRIC ELEVATOR; H. Rowntree, Chicago, Ill. App. filed Feb. 17, 1900. A signaling system by which an attendant located at the motor can be signaled from the different floors, whereupon he will adjust the controller to stop the car at the floor from which the signal is received.

666,706. SELECTIVE SIGNALING AND REGISTERING APPARATUS CIRCUIT; H. E. Shreeve, Dedham, Mass. App. filed Sept. 18, 1900. Details.

666,731. ELECTRO-MEDICAL EYE-GLASSES; P. Balme, Izieux, France. App. filed March 26, 1900. The frame is composed of copper and zinc so adjusted as to send a current through the nose when the eye-glasses are used.

666,737. BURGLAR ALARM SYSTEM; Clyde Coleman, Chicago, Ill. App. filed May 6, 1899. A thermo-electric pole, selenium cell or photo-electric impulsive cell within a safe or vault controls an alarm circuit.

666,744. TERMINAL FOR ELECTRIC CONDUCTORS; A. L. Ellis, Chicago, Ill. App. filed Feb. 12, 1900. The terminal consists of a socket having an oblique wall between which and the end of the conductor a wedge can be forced.

666,764. ELECTRIC CIRCUIT CONTROLLER; N. O. Lindstrom and A. Cowperthwait, New York, N. Y. App. filed July 6, 1900. A push-button which controls its own circuit, so that when the button is pushed inward it will remain in this position until the circuit is broken at another point.

666,831. DEVICE FOR INDICATING DISARRANGEMENT OF ARMATURES OF ELECTRIC MOTORS OR GENERATORS; J. T. Watson, Philadelphia, Pa. App. filed Aug. 16, 1900. An indicator to show when the bands on the armature become displaced.

666,849. DYNAMO ELECTRIC MACHINE; A. E. Jenney, Boston, Mass. App. filed May 5, 1898. The dynamos used in telephone systems are provided with peculiarly shaped pole pieces intended to prevent the whistling or humming sometimes heard in the telephone receivers.

666,861. PRINTING TELEGRAPH INSTRUMENT; L. M. Cassella, London, Eng. App. filed Oct. 20, 1899. Details.

666,874. ARRANGEMENT OF SWITCHING APPLIANCES IN CONNECTION WITH TELEPHONES; P. Rabbidge, Sydney, New South Wales. App. filed Feb. 26, 1900. Details.

666,883. COMMUNICATING SYSTEM; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1896. For telephoning and telegraphing simultaneously over the same circuit there are provided one or more sending and one or more receiving stations, a local source of current of rapidly alternating impulses connected through one terminal with the ground and through the other, with the interposition of a sending key and condenser, to the telephonic circuit.

666,900. AUTOMOTOR TROLLEY FOR ELECTRIC CURRENTS; L. Lombard-Gerin, Lyons, France. App. filed Nov. 10, 1900. This is a self-driven trolley adapted to run on the three wires of a tri-phase circuit.

666,912. SHIP'S TELEGRAPH; Leon S. Thompson, Washington, D. C. App. filed May 25, 1899. The receiver consists of a series of solenoids arranged circularly and having a core with a plurality of armatures in excess of the number of solenoids in a set. At the transmitter are contacts having electrical connections with the respective solenoids.

666,920. AUTOMATIC CUT-OUT DEVICE FOR USE IN CONNECTION WITH ELECTRICAL GENERATORS; M. S. Clawson, Weehawken, N. J. App. filed May 21, 1900. A cut-out device acting to disconnect the storage battery from the charging dynamo whenever the voltage of the dynamo falls below that of the battery.

666,933. ELECTRIC BELT; J. Moore and J. Murray, Providence, R. I. App. filed June 30, 1900. Details.

666,940. STATIC ELECTRIC MACHINE; J. Sorenson, Grand Rapids, Mich. App. filed Jan. 19, 1900. The passing current can be changed from a spark to a spray and the tensity of the current can be altered without altering the motion of the machine.

666,954. RELAY; S. G. Brown, Bournemouth, Eng. App. filed March 15, 1899. A device included in the relay circuit and suspended in the field of an alternating current magnet, is moved by the signaling currents received from the line, so as to induce alternating relay currents.

666,956. ELECTRIC CONNECTING HANDLE FOR AUTOMOBILES; E. N. Dickerson, Stovall, N. C. App. filed Nov. 5, 1900. The controlling circuit is held closed so long as the hand of the operator remains upon a controlling lever.

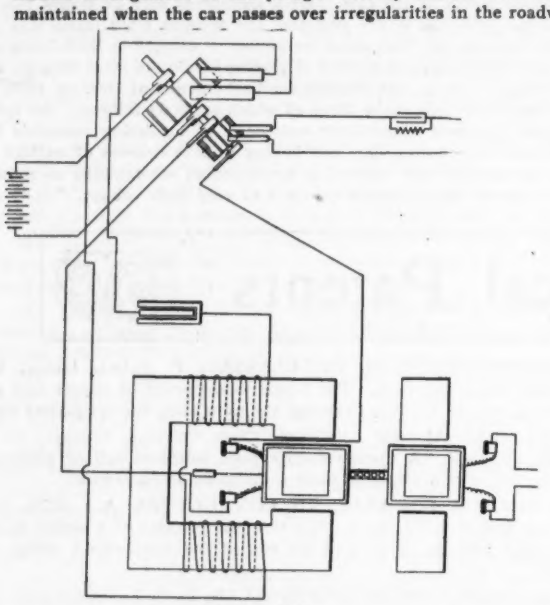
666,958. SELECTIVE SIGNALING; F. C. Ewing, Acadia, Va. App. filed Feb. 8, 1900. Details.

666,960. CABLE SUPPORTING CLIP; F. P. Fuller, New York, N. Y. App. filed Dec. 13, 1900. A strap and fastener for supporting one cable from another.

667,016. AUTOMATIC CORRECTOR FOR STEP BY STEP MECHANISM; C. O. Janney, St. Louis, Mo. App. filed Dec. 26, 1899. Details of a synchronizing apparatus.

667,028. ELECTRIC METER; A. D. Lunt, Schenectady, N. Y. App. filed Oct. 31, 1900. A field created by the measured current flowing through a certain winding is caused to rotate and the rotations are counted.

667,079. TRAVELING CONTACT FOR UNDERGROUND ELECTRIC RAILWAYS; J. Floyd, Washington, D. C. App. filed April 27, 1900. A flexible arrangement of the plough whereby contact with the conductor is maintained when the car passes over irregularities in the roadway.



666,954.—Relay.

667,095. ELECTRICAL TRACTION ON CLOSED CONDUIT SYSTEMS; H. Lane, Birmingham, Eng. App. filed Aug. 18, 1900. Relates to a system in which a magnet on the car lifts a flexible conductor in a closed conduit against contact plugs from which the car derives the current.

667,099. METHOD OF TREATING AND UTILIZING CHLORIN GAS; E. C. Paramore, Philadelphia, Pa. App. filed Feb. 21, 1900. The gas is passed through a chamber in which it is electrolyzed to nullify the odor and enhance its bleaching power.

667,100. APPARATUS FOR TREATING CHLORIN GAS; E. C. Paramore, Philadelphia, Pa. App. filed March 27, 1900. Relates to the preceding method.

667,103. INSULATOR; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 31, 1900. The wire passes through a metallic loop, the ends of which are locked inside of an insulator.

667,106. ELECTRIC ARC LAMP; E. Thomson, Swampscott, and C. E. Harthan, Lynn, Mass. App. filed Oct. 19, 1897. A magnet core consisting of a solid body having its exterior formed of thin sheet metal and its interior with lengthwise partitions of sheet metal and wires filling the compartment formed by the partitions.

667,107. ELECTRIC ARC LAMP; E. Thomson, Swampscott, and C. E. Harthan, Lynn, Mass. App. filed Nov. 4, 1897. Details in the construction of an inner globe and holder.

667,110. ELECTRIC RAILWAY; G. T. Woods, New York, N. Y. App. filed Sept. 29, 1897. Two sets of sectional conductors arranged in two distinct lines, a connection from one conductor in one line to one in the other, both sets being adapted to take current constantly from the feeding circuit and deliver the same in multiple to the car motor or motors as the car moves along, the conductors of both sets being normally dead, a normally open pick-up circuit including a source of electrical energy carried by the car, and a car-controlling switch mechanism whereby, when the car is being brought to rest, said pick-up circuit is closed.

667,113. SAFETY DEVICE FOR DYNAMO-ELECTRIC MACHINES; H. W. Buck, Schenectady, N. Y. App. filed March 11, 1899. (See Current News and Notes.)

667,114. MEANS FOR PREVENTING HUNTING OF DYNAMO ELECTRIC MACHINES; H. W. Buck, Schenectady, N. Y. App. filed April 28, 1900. (See Current News and Notes.)

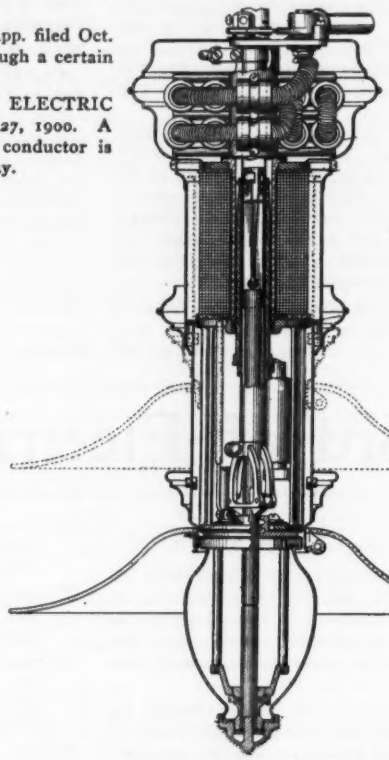
667,115. BURGLAR ALARM SYSTEM; C. Coleman, Chicago, Ill. App. filed July 12, 1898. A number of barriers are inserted between the alarm apparatus and the exterior of the structure protected, the destruction of which must be effected before the alarm can be tampered with.

667,119. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed Aug. 29, 1898. Details.

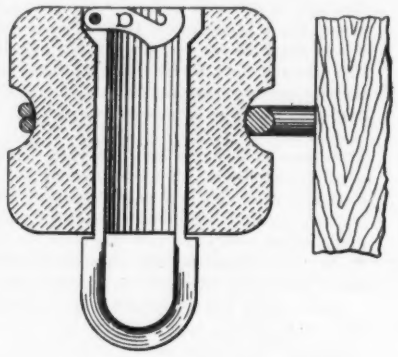
667,120. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed Nov. 9, 1898. A magnet is used to assist the release of the clutch each time the clutch is tripped.

667,121. ELECTRIC ARC LAMP; R. Fleming, Lynn, Mass. App. filed March 2, 1899. The pull of the armature is rendered uniform by utilizing the reactance introduced into the circuit of the solenoid by the changed position of the armature with respect to the coil.

667,122. ELECTRIC ARC LAMP; R. Fleming, Swampscott, Mass. App. filed Nov. 12, 1900. In an alternating current lamp a spool contains two windings in inductive relation to each other, which windings are included in the circuit at the same time.



667,119.—Electric Arc Lamp.



667,103.—Insulator.

667,123. ELECTRIC PROTECTIVE SYSTEM; H. F. Freed, Harrisburg, Pa. App. filed Aug. 31, 1900. When the alarm is once sounded, it continues and can only be stopped by a person having the keys to a switchbox.

667,124. SIGNAL BOX; H. F. Freed, Harrisburg, Pa. App. filed Aug. 31, 1900. The box is provided with a cover having openings to emit the sound of a signal therein and other openings to show a light.

667,125. ELECTRICAL CONNECTOR; H. F. Freed, Harrisburg, Pa. App. filed Sept. 27, 1900. Details of a circuit closer for burglar alarm systems.

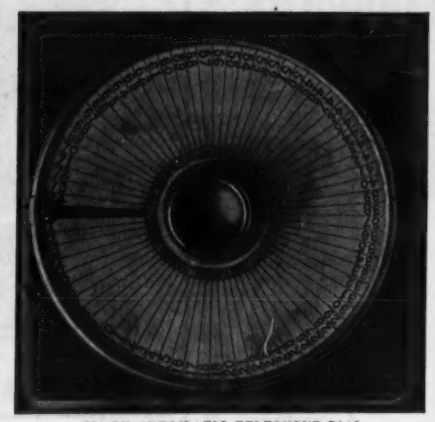
667,128. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed July 27, 1898. Relates to the ornamental features of the casing.

667,129. ELECTRIC ARC LAMP; C. E. Harthan, Lynn, Mass. App. filed Oct. 2, 1899. Details intended to improve and simplify the construction of focusing lamps.

667,130. LOAD-EQUALIZING APPARATUS FOR DYNAMO-ELECTRIC MACHINES; Edward M. Hewlett and Hermann F. T. Erben, Schenectady, N. Y. App. filed March 27, 1900. Brush adjusting arrangement for machines with two commutators. The brushes of each machine may be simultaneously or separately adjusted.

667,133. PNEUMATICALLY CONTROLLED TROLLEY; J. B. Linn, Schnectady, N. Y. App. filed Nov. 13, 1899. An air cylinder is mounted upon the turn-table of a trolley pole and its piston is connected to the pole, so as to control its vertical movement.

667,144. STATIC ELECTRIC MACHINE; C. H. Cook, Indianapolis, Ind. App. filed Jan. 2, 1900. Means are provided for generating a powerful supply of electricity immediately after the start, and without the aid of an exciter.



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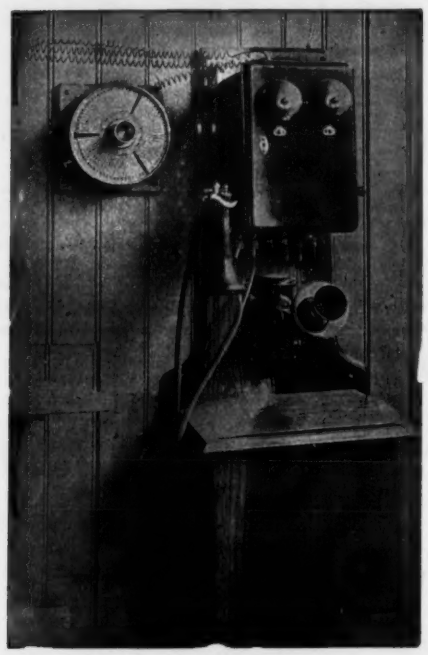

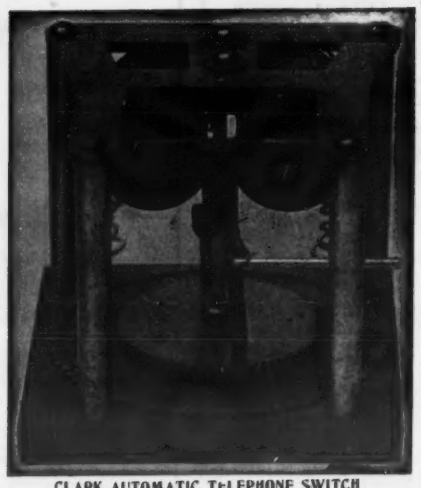

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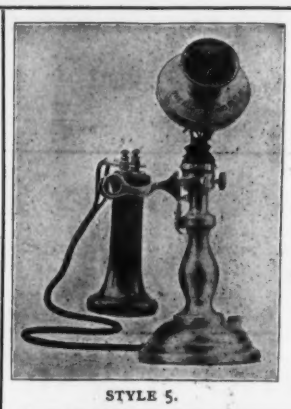

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